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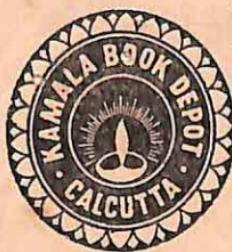
ALLOCATION
OF
PUPILS
IN
SECONDARY EDUCATION

VOLUME ONE

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A. I. E. (London)

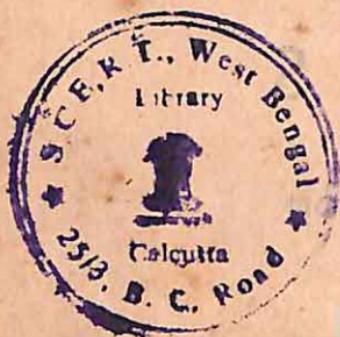
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KAMALA BOOK DEPOT, CALCUTTA.

1960

First Published
in
December, 1960



371-42
MAH
V,

Bureau Edn., Pay. Research
1710 H.A.T. TRAINING COLLEGE
Dated 10. 6. 1966
Acc. No. 1949

RUPEES FOUR & NAYE PAISE SEVENTY-FIVE ONLY

S.C.E.R.T., West Bengal
Date ... 10. 6. 66 ..
Acc. No. 1949 ..

Published by Shri Sukumar Chatterjee for and on behalf
of M/s Kamala Book Depot, Calcutta 12 and Printed by
Shri M. K. Mukherjee at The Temple Press, Calcutta 4.

FOREWORD

Education for living and education for life—both of these are enshrined in the vision of the educators of the new India and a fitting contribution to their realisation is presented in this scholarly survey of the complex process of guiding boys and girls as they grow towards productive, co-operative and intelligent citizenship in a modern democracy. No easy solution is attempted and due regard is paid both to recent evidence from genetic and social psychology and to the technicalities of psychometrical analyses. The pool of human ability is both wider and deeper than was formerly supposed. Human beings have potentialities as yet unrealized and their success is a function of their total history with its expression in interests, ambitions and present competencies. Prediction is at all times hazardous ; but interpretation wisely used can serve to foster insight and self-direction. In this faith Professor Mahanta brings all the resources of recent research to the formulation of a procedure through which young people, their parents and their teachers may unite to secure wise allocation to available courses of advanced secondary education.

This is a book to buy and to study.

*University of London,
March, 1961.*

C. M. FLEMING

PREFACE

The Government of India at the Centre as well as the Governments of different States in the Indian Union have been much concerned about multilateral education ; and multilateral education, in its turn, is very intimately associated with the issue of allocation of pupils to different streams of diversified courses. This problem of allocation is most delicate, momentous and baffling ; but we cannot avoid it, and the most thorough investigations are necessary if we are to arrive at a plausible and workable solution.

Although I have been able neither to do justice to this complicated question nor to produce a very satisfactory scheme or plan of work, I hope that this brief guide will prove of use to educators, to administrators and to all those who come to study the problem for the first time. I have been concerned here to describe the background against which the 'allocation' problem should be studied and also to find out the procedures, methods and techniques which might best help those who would be asked to tackle the problem in the near future. If this work is of any use to future workers and researchers in education I shall feel richly recompensed.

I would like gratefully to acknowledge the help I received from my respected tutor, *Dr. C. M. Fleming*, Reader in Education, University of London Institute of Education, as well as from the following Institutions :

- (a) *University of London Institute of Education.*
- (b) *The Imperial Relations Trust (U. K.)*
- (c) *The Ministry of Education, Government of India.*
- (d) *The Department of Education, Government of West Bengal.*

I am also indebted to the educationists and the psychologists on whose works I have so largely drawn.

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CHAPTER I

Introduction

All who are interested in the development of Indian education know that immediately after the country gained her long-cherished independence in 1947, a commission, known as the "University Education Commission of India" was set up under the chairmanship of Dr. S. Radhakrishnan, the present Vice-President of the Indian Sovereign Republic. The Commission was asked to make a thorough study of the existing system of University Education and to make practical recommendations for building a sound 'University Education System in Free India.' But many people, especially the eminent educators who had to implement the educational development in different States, felt that the Secondary Education System was the weakest part of the structure and that attempts should therefore be made to investigate the causes of failure in the existing system and to reconstruct a solid and sound secondary education upon which the superstructure of university education could securely rest. It was also felt that a clear, distinct and definite policy of secondary education should be laid down on an all-India basis.

The Secondary Education Commission:

Fortunately the Government of India responded favourably to that demand. A Secondary Education Commission under the Chairmanship of Dr. A. L. Mudaliar was set up in 1952. It was categorically stated in the introductory part of the Commission's Report¹ that (one of the fundamental rights guaranteed by the Indian Constitution was the right of every citizen of the Union to free and compulsory education upto the age of fourteen.) For the proper functioning of democracy, the Government at the Centre must see that every individual was

¹ The Report of the Secondary Education Commission, Government of India, 1952-53, p. 5.

equipped with the necessary knowledge, skill and abilities to discharge his or her duties as a responsible and co-operative citizen. In other words, there should be a system of balanced education in which social virtues, intellectual development and practical skill would all be considered.

Pattern of Indian Education prior to 1952-53:

Prior to 1952-53, the general pattern of educational organisation in India was roughly of the following type, though there were slight variations in the structure from State to State, from region to region or from university to university.

(A rough sketch of the educational structure in India prior to 1952-53)

Type of education	Age-group of children
(a) Pre-primary, Nursery and/ or Kindergarten Education.	from 3/5 years to 5/7 yrs.
(b) Primary Education.	(Usually of 4/5 yrs' duration) from 5/7 yrs to 9/11 yrs.
(c) Middle School Education.	(Higher Elementary, from 9/11 yrs to Middle English or 11/13 yrs. Middle Vernacular)
(In many of the States, the middle schools were either attached to the next higher institutions i.e. the secondary schools or to the preceding lower institutions i.e. the primary schools).	
(d) Secondary or High School-Education.	(Usually of 3/4 yrs' duration) from 11/13 yrs to 15/16 yrs.
(e) Higher Secondary Education.	(Only a limited number of higher secondary schools existed in certain States until 1952. Normally these schools had their courses extended by one year more than the ordinary secondary courses, the additional year being taken out of the intermediate stage of collegiate education).
(f) Collegiate Education (General)	(Usually of 4 years' duration, 2 years of intermediate and 2 years of degree course. In case of students passing out

of higher secondary schools, there was only the 3 years' degree course).

(Some of the colleges would provide only the Intermediate Course of 2 years).

Outside this structure of general education, there were some institutions providing professional or vocational education through schools and/or colleges of diverse types, e.g. Commercial, Industrial, Technical, Engineering, Medicine, Agriculture, Veterinary Science, Teacher-Training, etc.

Proposed structure of the educational organisation:

After a good deal of thought over the varied patterns of the education system of different States and also over the new ideals of democratic education to be attained by the country within the shortest possible time, the Secondary Education Commission suggested the following organisational structure upto the secondary stage.

<i>Schools or Institutions.</i>	<i>Age of Children.</i>
(a) Nursery or Pre-Primary	Upto the 6th or 7th year
(b) Primary or Junior Basic (4 or 5 years' duration)	Upto the 11th year (i.e. from 7 or 8 to 11)
(c) Middle, Senior Basic or Junior Secondary (3 years' duration)	Upto the 14th year (i.e. from 12 to 14)
(d) Senior, Higher Secondary or simply Secondary (4 years' duration)	Upto the 18th year (i.e. from 15 to 18)

(For the period of transition, however, the Commission recommended a higher secondary course for only 3 years i.e. from 15 to 17).

The Commission expressly stated¹ that particular care should be taken to make the first 7 or 8 years of schooling (in either the Primary or Junior Basic stage and subsequently in the Middle, Senior Basic or Junior Secondary stage) (an integrated and complete whole, so that when free and compulsory education would be ex-

¹ The Report of the Secondary Education Commission, Government of India, 1952-53 p. 32.

tended upto the age of 14, as envisaged in the Constitution, education upto that stage could be considered as constituting a basic pattern, more or less uniform throughout the country.

Most of the recommendations of the Commission were endorsed by the Government of India, Central Advisory Board of Education, in January, 1955.¹ The Board, however, felt that in order to be more definite about the desired uniformity of standard there should everywhere be *eight years* (not seven or eight years as envisaged by the Commission) of integrated Elementary (Basic) education for children from 6 to 14 and *three years* of secondary education proper for children from 15 to 17. Thus the plan would be either 5-3-3 or 8-3 upto the end of the secondary stage.

Implications of the proposed scheme:

When this 5-3-3 or 8-3 plan could be put into operation and when education up to the age of 14 could be made free, universal and compulsory, quite a large number of pupils with a very wide range of abilities and interests would be passing out (after eight years of integrated education) from the Elementary (Basic), Junior High or Senior Basic Schools. Towards the end of this compulsory education, the schools should offer varieties of subjects, experiences and activities to meet, foster and develop the diverse abilities and interests of the young learners.

It was also emphasized by the Commission that secondary education should be made more or less complete by itself, a finishing education and not a fitting one—an education for life and not merely a preparation for entrance into universities.)

As a necessary corollary to the above, the higher secondary schools would provide adequately diversified courses to accommodate pupils of different grades of ability, attainment and interest. Of course, it might be that in the near future only 20 to 25 per cent of the total number of children completing compulsory educa-

¹ A Plan for Secondary Education—Ministry of Education, Government of India, 1955 p. 1-9.

tion at the age of 14 would go on to higher secondary schools and that the remainder (75 to 80 per cent) would go in for full-time employment or have continuation or part-time education in trade schools, vocational centres or occupational institutions. But it would not be long before our National Government would endeavour to give higher education to all the members of our younger generation.

Obviously, the secondary schools would then have to be multiplied in larger numbers and furnished with varieties of courses. Probably most courses now followed in trade schools, the lower forms of vocational, occupational or professional institutions or other types of part-time continuation-education-centres would be raised in due course to the dignified (?) status of secondary education.

Diversification of Courses :

We have just used the word 'dignified' to describe our 'Secondary Education'. This point, perhaps, needs further clarification. The Commission explicitly stated¹ that the diversification of courses and the introduction of many practical subjects at the secondary stage would not mean that something called general or cultural education was to be provided for one group of students, while others were to be given a narrow practical or vocational education. The modern approach is based on the proposition that intellectual and cultural development of different individuals is best achieved through a *variety of media*, that the study of traditional academic subjects is not the only door to the education of the personality, and that for the majority of children, practical work intelligently organised can unlock their latent capacities much more successfully than traditional subjects which address themselves only to the memory. If the above principle of secondary education is clearly understood, educationists must see that all these *diversified courses are accorded parity of esteem, social prestige or dignity*

¹ Report of the Secondary Education Commission, Government of India, 1952-53, pp. 38-39.

and that students are adequately helped to select one of them with due regard to their natural interests and talents.

Moreover, as all the students have to be trained in certain basic ideas, attitudes and appreciations which are considered to be essential for playing a useful role as intelligent citizens in a democracy, there should be a common 'Core' of subjects of general value and utility which all students must study.

Of course a wise teacher should realise that practical subjects, provided they are rightly taught, can also contribute to the all-round education of the students, making them productive, co-operative and well-balanced members of society.

'Core' subjects for the Higher Secondary Stage :

In the report of the University Education Commission of 1948-49 it was suggested that¹ general education at the secondary stage should include an acquaintance with one's physical environment, an introduction to the basic ideas of the physical and biological sciences, precise and effective use of language as a means of communication, an appreciation of the higher values of life as enshrined in literature and an understanding of the processes involved in working and living together.

The Secondary Education Commission probably gave these objectives due consideration when they suggested the following Core-curriculum for the higher secondary stage.

- (1) Mother Language or Regional Language.
- (2) Federal Language (or any Modern Indian Language for those whose mother language is the same as the federal language).
- (3) English (as an International Language).
- (4) General Science including Mathematics.
- (5) Social Studies.
- (6) A Craft.

Besides the above 'Core' subjects, the Commission recommended that three other subjects should be studied

¹ Report of the University Education Commission, Government of India, 1948-49, p. 125.

by students from any one of the following groups.¹

Group.

Subjects.

(a) Humanities	Classical Language, History, Geography, Elements of Economics and Civics, Elements of Psychology and Logic, Mathematics, Music, Domestic Science.
(b) Science	Physics, Chemistry, Biology, Geography, Mathematics, Elements of Physiology and Hygiene.
(c) Technical	Applied Mathematics and Geometrical Drawing, Applied Science, Elements of Mechanical Engineering, Elements of Electrical Engineering.
(d) Commerce	Commercial Practice, Book-keeping, Commercial Geography or Elements of Civics and Economics, Shorthand and Type-writing, General Agriculture, Animal Husbandry, Horticulture and Gardening, Agricultural Chemistry and Botany.
(e) Agriculture	History of Art, Drawing and Designing, Painting, Modelling, Music, Dancing.
(f) Fine Arts	Home Economics, Nutrition and Cookery, Mother Craft and Child-Care.
(g) Home Science	Household Management & Home Nursing.

The Central Advisory Board of Education, Government of India, suggested a few modifications to the content-structure of the above groupings. The new "groupings" as described in 'the Draft Syllabus for Higher Secondary Schools', issued by the All India Council for Secondary Education, on behalf of the Ministry of Educa-

¹ Report of the Secondary Education Commission, Government of India, 1952-53, pp. 86-100.

tion, are given below:¹

(a) Humanities— Languages e.g. Classical, English, etc.
(Any three)

History, Geography, Elements of Economics and Civics, Elements of Psychology and Logic, Mathematics, Elements of Home Science, Music.

(b) Science—
(Any three)

Physics, Chemistry, Biology, Geography, Mathematics, Elements of Physiology and Hygiene, Elements of Home Science.

(c) Technical—

Compulsory Subjects:

- (i) Applied Mathematics and Science.
- (ii) Geometrical and Mechanical Drawing.

Any one of the following:

Mechanical Engineering, Electrical Engineering, Elements of Building Construction, Radio Engineering.

(d) Commerce—Compulsory Subjects:

- (i) Elements of Commerce, including Economics and Civics.
- (ii) Commercial Geography.

Any one of the following:

Book-keeping, Shorthand and Typewriting.

(e) Agriculture—Compulsory Subjects:

- (i) Agricultural Biology and Chemistry.
- (ii) General Agriculture including Soil management and crop-culture with special reference to any one of the following—

Horticulture.

Crop-culture.

¹ The Draft Syllabus for Higher Secondary Schools issued by the A.I.C.S.E. on behalf of the Ministry of Education, Government of India, 1956.

Fruit growing and fruit preservation.
Poultry farming.

(iii) Farm Management including Animal Husbandry and Dairying.

(f) Fine Art—Compulsory:
Appreciation of Art (including History of Art).
Optional:—Drawing and Painting, Modelling and Sculpture, Music and Dancing, Elements of Home Science.

(g) Home Science—Compulsory Subjects:
Household Management, Food Nutrition and Cookery, House keeping including nursing, child development and mother craft. Practical work included.

Multilateral School :

All these diversified courses or any combination of them would be provided in the proposed higher secondary or multilateral schools. These multilateral schools usually go by the name of 'multi-purpose' schools. Perhaps the choice of the term 'multi-purpose' has not been a happy one as it fails to denote the actual nature of our higher secondary education. Besides, the term 'multi-purpose' may easily be construed to have undesirable socio-economic insinuations rather than the desired psycho-educational implications.

Anyway, these multilateral schools should endeavour, through the provision of diversified courses, to extend to each pupil suitable opportunities to use, develop and utilise his natural abilities and interests. The special features of the multilateral schools can be summarised as follows:—

(a) These schools would remove individual distinctions between students preparing for different courses of studies by breaking down the sense of inferiority traditionally associated with vocational subjects. They would thus make it possible to plan an educational system on a truly democratic basis.

(b) These schools would provide a greater variety of educational media and thereby facilitate, through proper

educational guidance, the selection of right courses and subjects.

(c) These schools would help to solve the problem of wrongly classified pupils, because transfer within the same school from stream (group) to stream (group) or from subject to subject, would certainly be easier to arrange than transfer from one school to another of different type.

Diversified Courses and Educational Guidance:

It is obvious that any change introduced in any part of the education system would entail corresponding changes in other directions. The provision of diversified courses at the secondary stage would necessarily impose on teachers and school administrators the additional responsibility of giving proper educational guidance to pupils in their choice of courses or subjects and perhaps also their subsequent careers.¹ One may reasonably enquire here about the real meaning of educational guidance. ✓Educational guidance, as suggested by the Commission, can be described as a process of helping pupils to discover their potentialities and thus develop themselves through their own effort by following a particular course or line of studies for the good of both the individual and the society.

Educational guidance² is a process, not an end-result, and, in that process, the individual pupil is to develop through his own effort. Teachers, administrators, psychologists and guidance workers are there only to help the individuals discover or see their abilities, attainments and interests. They are also to encourage in the individual pupils the traits of initiative, self-confidence, industry and perseverance, which are usually considered to be essential for the purpose of living an effective social life. Such a developmental view of *guidance* is indispensable if we really want to help the pupils make suitable educational plans. Thus the secret of good educational guidance lies in enabling the pupils to realise what their

¹ The Report of the Secondary Education Commission, Government of India, 1952-53, pp. 139-43.

² The Year Book of Education, 1955, pp. 603-606.

individual abilities and interests are, and also how, in which line of study or work and to what extent they can best develop these traits, in order to achieve maximum happiness as useful citizens. Educational guidance is not to be considered a mechanical process, for it involves the most difficult art of helping the pupils plan their future educational career in the wisest possible way and in the full light of all the available information that can be gathered about the pupils themselves as well as about the related factors in the world in which they are to live, work and prosper. Naturally then, guidance is to be provided in the most appropriate way through the co-operative endeavour of the enlightened pupils, understanding parents and experienced teachers. The task of discovering the potentialities of pupils will evidently imply the use of various available methods of child-study and appraisal, ranging from incidental observation and casual conversation to standardised tests and clinical interviews. The data thus collected from all possible sources together with their wise interpretation by sympathetic teacher-counsellors hold out the promise of a satisfactory solution of the problem.

Bureau of Educational Guidance :

The Secondary Education Commission fully realised the immensity of the difficult task of offering guidance services to pupils of the proposed multilateral schools when they unhesitatingly stated¹ that the Government at the Centre should take up the responsibility of organising these services through a Central Bureau. The primary task of the Bureau would be to take the initiative in this direction, by training suitable personnel to man the guidance-organisations in different States and to carry out research work in connection with the preparation of standardised tests and other tools, with particular reference to the Indian conditions, the needs of the pupils concerned and the opportunities available for them from time to time.

The 'Bureau' should also try to prepare the field for

¹ The Report of the Secondary Education Commission, Government of India, 1952-53 p. 143.

introduction of guidance activities in schools. The community conditions of many a locality should be moulded, modified and developed in such a way that it would be possible for the people to accept the guidance services that are offered in schools. Otherwise, ignorance, bias or prejudiced attitudes and superstitions, pan-economic interpretation of everything in life, false prestige, etc. might defeat the plan altogether. Such things disturb quite often the most well-thought-out schemes of educational reconstruction. Kandel says¹—“More important perhaps and more difficult than putting the fundamental principles and a system of guidance into practice, is the task of convincing parents of the soundness of any professional advice that may be offered them about the education of their children”.

In accordance with the above recommendations of the Commission, [duly considered by the Central Advisory Board of Education² and the International Team of Experts sponsored by the Ford Foundation in India,³] the Central Government has already set up a ‘Bureau of Educational and Vocational Guidance’ at the Centre and helped setting up similar ‘Bureaux’ in different States with local initiative and co-operation. The Bureau at the Centre is to co-ordinate the guidance work done at different State Bureaux and/or at some of the State Universities into an organised system. It is also to initiate research-work and other related activities, of long-range as well as immediate value or implication in guidance work, especially at the secondary school level.

Since 1955-56 the Central Bureau of Educational and Vocational Guidance along with about a dozen such Bureaux at different State-centres has been striving hard at some workable solution of the problem of introducing and organising guidance services in our secondary schools.

¹ Kandel I. L.—*The New Era in Education*, George G. Harrap & Co. 1955, p. 105.

² Proceedings of the 20th and 21st Meetings of the C.A.B.E., Government of India, 1954, pp. 291-301.

³ Teacher and Curricula in Secondary Schools, Report of a Study by an International Team, The Ford Foundation, New Delhi, 1954 pp. 89-90.

Some of the Universities also have lent valuable support in the matter through their Psychology and/or Education Departments. But unfortunately many a teacher, (not to speak of the laymen, the parents), still hesitate to accept the applicability and/or justifiability of the techniques or methods to be followed for the purpose. Perhaps, there are reasons for such hesitation.

CHAPTER II

The Problem

After the profound disturbances of war or revolution, or after the achievement of independence, it is natural that reform should concern itself to improve the material life of the people. Such reform is inseparably connected with changes in the existing social and cultural order and with education, and invariably involves *re-education* of the people—in the sense of reorienting their attitudes, habits, motivation and faith. This is especially true in under-developed countries aspiring for an accelerated growth of their material, social and cultural life. (It is here all the more important that re-education and re-organized systems of secondary education should be sustained by a sound philosophical basis and a solid pedagogical sub-structure. With this the conception of educational guidance with respect to selection of courses is intimately involved.

We have suggested in Chapter I that our problem deals with the kind of guidance that children can be offered when they face the important decision of choosing between a number of courses (e.g. humanities, science, technical, commercial, etc.) at the end of their Elementary (Basic) or Junior High School stage (i.e. after class VIII). In our new secondary education system we must aim to lead our young people smoothly towards full, useful and happy lives.

The problem may be studied in its three different aspects :

- (1) A number of intricate scientific and analytical issues are involved, on whose right solution depend all our hopes of improvement to the present system.
- (2) There are the administrative complexities connected with the actual organization of guidance services in schools.

(3) The teaching profession has to be trained and equipped so that it can win an increasing respect for its new role of teacher-counsellor.

Here we will be interested principally in the first aspect of the problem (i.e. the scientific aspect), the second and third aspects being considered only incidentally.

Basic Assumptions :

There are certain assumptions that we make and which underlie the process of guiding children in the choice of their educational career. We assume that:

(i) Children differ from each other in such traits as general mental ability, interests, attitudes, etc. and these differences are to be respected.

(ii) The diversified courses introduced at the end of eight years of integrated elementary education (i.e. for children of 14 plus) are adequate to meet the diverging needs of children in the present cultural and socio-economic set-up of the country.

(iii) Successful achievement in these diversified courses depends mostly on varying degrees and patterns of abilities, interests and attitudes etc., in respect of which individuals are alleged to differ.

(iv) It is in the best interest of the pupil and the society that children going on to higher secondary education should be offered 'guidance' on the grounds that most pupils and their parents are not so well developed or trained that they are able to solve for themselves the issue of curricular selections without some sort of formal external assistance.

Other minor assumptions are likely to be implicit in the scheme, but those listed here are probably adequate to our purpose to bring out the immensity and complexity of the problem concerned.

CHAPTER III

Individual Differences

The first assumption made at the end of the previous chapter is obviously the most important. Human beings are so richly varied in intellect and personality that one cannot but take note of the variations. The individuals differ amongst themselves in respect of abilities, interests, and other personality traits and that these differences are so vital that a demand is consistently made to respect these differences, while organising the education system of a *democratic* society.

Ever since the dawn of scientific psychology, there have been many talks and discussions about these 'individual differences'. An enormous literature has developed round them and we now often hear of *differential psychology* as against *general psychology*. It is tempting to discuss the various points of view of different psychologists. Some of the important views, especially in regard to abilities and interests, are discussed in detail in the next two chapters.

A simple statement like 'human beings are found to differ amongst themselves' may not meet serious objections. But when specific issues of the type 'Why do individual differ?' 'To what extent do they differ?'.... 'At what stage do they differ much?' 'Which trait shows the greatest variation?' are raised, it becomes really difficult to find answers which might be accepted by the majority.

On the whole, the older psychology has either gone to undue lengths to get rid of variability from behaviour, or recognising it, has landed the whole subject in a welter of assertions¹. It has been claimed that, on the basis of abilities, interests, or other personality traits, individuals should be classified into so many 'types' or distinct 'cate-

¹ Bartlett F. C.—'Fifty years of Psychology'—Occup. Psychol. 29, No. 4, Oct. 1955, p. 216.

gories'. But later developments in psychometry have shown that the classification of individuals by "types" has been ill-founded, variations in men being gradual and continuous. Such opposing views are not very rare. Some regard these differences as natural and real, while others consider them artificial or man-made, and therefore superficial. According to the former group these differences are to be scrupulously respected and all possible arrangements made for their 'unchartered' development, whereas people of the latter group would wage war against all these differences and would fight to the last for their complete eradication. But these are extreme view-points and they are likely to culminate in abstruse discussions of ideological conflicts or philosophical controversies. For us, educators, the proper course would, perhaps, be to face these variations squarely. We need not bother about the true causes of these variations or about the relative superiority of 'heredity' and 'environment' in determining the nature or extent of these variations.

But how are we to respect these differences in the field of education? Even if the reality of these differences among individuals is admitted, how are they to be rightly assessed for their subsequent recognition and treatment? Should we take recourse to the measurement of human minds? Which trait or traits of human mind should we measure for the purpose,—abilities, attainments, interests, attitudes or some other important personality traits?

As we are principally concerned here with the classification of individuals into a few 'types', it is necessary for us to know which aspects of personality (ability, attainment, interest, attitude, etc.), we should rely on for such classification. It is often suggested that human individuals cannot be satisfactorily classified according to any single dimension of personality, let alone a single dimension of ability¹.

Evidences are being accumulated to show that individual differences in performance or ability, revealed on the occasion of testing, may not be so indicative or predictive

¹ Frandson Arden N.—'How Children Learn' McGraw Hill Book Company Inc. (1957), p. 356.

of later differences in work or life as to justify differentiated training or treatment at an early age. Long-term studies on human development have shown that there may not be only *one pattern of human behaving* at any stage and that the full realisation of an individual's potentialities should not be expected in early or late adolescence. "The child's development is continuous. It is never possible to describe an individual once for all".¹

Moreover, the intra-personal variations (i.e. disharmony in the individual's own growth or development at different periods of his life) should be given as much consideration as the inter-personal variations (i.e. differences among individuals). In other words, fixity of relative status of an individual with respect to his future performance should not be accepted as a matter of course. It has, for example, been stated that "the possibility of producing marked changes in relative status has been demonstrated by evidences, that very great improvement can be secured by *suitable training* accompanied by *adequate encouragement*."² Interest, industriousness and motivation can bring about far-reaching changes in the functioning of an individual. Apparently, there appears to be "no justification for supposing that it is possible to assess completely what a human being can do in the future from mere observation of what he does do in the present or has done in the past."³

But is there, then, no solution to our problem? It seems that we have got to reconcile the demand for fixity of behaviour-trends (which is so very essential for prediction) with the almost incompatible demand for fluent adaptability. "Perhaps it may be possible to determine degrees of freedom within which the constituent items of complex behaviour are expressed, and so to understand and, where necessary, to control behaviour without reduc-

¹ Hamley H. R., et. al.—*'The Educational Guidance of School Child'*, Evan Brothers, Ltd., London, p. 18.

² Fleming C. M.—*'Adolescence'*, Routledge, Kegan Paul & Co. 1948, Chap. X, p. 123.

³ Fleming C. M.—*'A note on aptitude testing'*—N.U.T. Report on Transfer from Primary to Secondary Schools—1949, pp. 154-57.

ing it to repetitive routine, but still treating it as lawful and orderly.'¹

We continue our discussion on this important problem in the next two chapters, especially the two most crucial points, (i) the nature of human abilities and their patterns and (ii) the correspondence between the nature of human variations and the types of diversified courses provided in our multilateral schools.

¹ Bartlett F. C.—'Fifty years of Psychology'—Occup. Psychol.—29, No. 5, p. 216.

CHAPTER IV

Abilities and their pattern

A. THEORETICAL ISSUES

Workers in the field of Psychology and Education have all along been carrying on various types of investigation to penetrate the mysteries that surround human variations. Many of them have devoted themselves to the task of explaining the complexity of human behaviour in terms of a few fundamental or primary components which would readily account for and determine these variations and thus make predictions about human behaviour possible or practicable.

Traditional Theories:

Before the beginning of the present century, there were three major theories of human ability, which Spearman deftly termed as '*monarchic*', '*oligarchic*' and '*anarchic*'. These three theories were developed mostly on logical analysis, rational observation or speculative intuition.

According to the monarchic view, all functioning of an individual could be explained in terms of one 'all round' mental power, namely, intelligence, and, consequently, variations among individuals should be interpreted in terms of differences in degree of the said intellectual ability; an individual's success in any situation would invariably depend on the degree of his general intellectual power.

The advocates of the oligarchic view were of opinion that human behaviour could be determined not by a single general power but by a number of independent faculties like attention, imagination, memory, observation, reasoning, judgment, etc. and that individual differences should therefore be explained in terms of these faculties. In other words, an individual might possess these independent faculties in varying degrees and the nature of

the distribution of these faculties in that individual would determine the extent of his success in actual life.

The anarchic school of thought suggested that human behaviour, when properly analysed, would ultimately be reduced to a very large number of 'bonds' (stimulus-response or S-R bonds) and that all these bonds should be considered as more or less independent of each other. Naturally the supporters of the anarchic view would not admit the existence of either a single unitary power or a number of broad independent faculties, unifying or controlling all the functioning of an individual and thus determining his success in different situations. The success of an individual in any specific activity should rather be regarded as a complex function of the individual's 'repertoire' of S-R bonds, the needs or demands of the particular situation and the temporal *relation* between these two.

Spearman's Theory:

Towards the first decade of the 20th century, people came to hear of the famous *two-factor* theory of Charles Spearman, the so-called 'Newton' in the field of psychological measurements. According to him,¹ human ability might be regarded as composed of two 'Components'—(a) the general factor or 'g'—a sort of all round mental ability which would seem to be universal in character, in the sense that it would enter into all the functioning of an individual and (b) a set of specific factors or S's which are unique in character, each entering into only one particular functioning of an individual.

This two-factor theory of Spearman substantiated though it was by statistical procedures could not readily satisfy some of the famous psychologists of that age including Thorndike, Kelley and Thurstone; all of them vigorously opposed it on the ground that it was an unjustified attempt to oversimplify the complex nature of human ability.

Spearman and his followers also could not maintain their original stand in view of the later findings. The

¹ Spearman C.—'The Abilities of Man', The Macmillan and Co.
1927.

'two-factor' theory, as we shall see afterwards, had to be modified a bit, to incorporate at least a few broad 'group-factors' (like verbal, numerical, spatial, etc), which were supposed to be broader than the specific factors (S's) but less broad than the 'g', in the sense that they could enter into a number of activities (not merely one particular activity) of an individual, but not into all activities like the 'g'.

Thorndike and Kelley:

Thorndike suggested that there were three different types of intelligence¹, (a) abstract (b) social and (c) mechanical, corresponding to the three major areas of our intellectual life, namely, (i) the academic (scholastic) (ii) the social (human relations) and (iii) the mechanical (concrete-manual) respectively. According to Thorndike, then, we are first to determine the type of intelligence that is predominant in an individual in order to make predictions about the area of life in which he is likely to succeed most.

Kelley claimed to have established² three other types of intelligence, (a) verbal, (b) quantitative and (c) spatial, corresponding, perhaps, to the three broad aspects of educational life, namely, literary or linguistic, mathematical or scientific and technical or mechanical respectively. These three types of intelligence were shown by him as independent of each other. He also remarked that the determination of such *independent* types of ability would turn out to be a very useful aid for educational classification and guidance.

Thus in terms of Spearman's theory, the individuals would differ in respect of only one type of intelligence i.e. *general intelligence*, which is alleged to be common to all the activities of human life. So once we make satisfactory arrangements for assessing the general intelligence of an individual, we can predict to a great extent his future achievements, at least in the normal sphere.

¹ Thorndike E. L.—*Intelligence and its uses*, Harpers, 1920, pp. 227-35.

² Kelley T. L.—*Interpretation of Educational Measurements*, World Book Co. 1927.

of work. But in terms of either Thorndike's or Kelley's contentions, there are different 'types' of intelligence all of which are to be considered while describing an individual's intellectual status. The problem before us should, then, be to determine the degrees of all these 'types' of intelligence of an individual, to make a comparative study of these *type* and finally to attempt at predicting his *future* achievement in a particular field. In other words, instead of differentiating individuals on the basis of one *general intelligence* alone, we have now to investigate the distinction between 'types' as given below:

Abstract, Social and	}	According to Thorndike
Mechanical		
Verbal, Quantitative	}	According to Kelley.
and Spatial.		

Later investigations supported some of the claims of Thorndike and Kelley. Against Thorndike's mechanical intelligence, we get Cox's 'm' (mechanical aptitude) factor;¹ against his abstract intelligence and opposite to it, we have Alexander's 'F' or practical factor². Against Kelley's verbal intelligence, we have Stephenson's verbal (v) factor³, and against his spatial intelligence we have El Koussy's 'k' (space-perception) factor⁴. All these factors m, F, v or k are, however, regarded as so many broad 'group' factors centering round the general factor 'g'.

Thurstone's Theory :

Thurstone⁵ came with his list of seven 'primary' mental abilities,—

¹ Cox J. W.—*Mechanical Aptitude—its existence, nature and measurement*—Methuen & Co., Ltd., 1928.

² Alexander W. P.—'Intelligence, Concrete, and Abstract'—Brit. J. Psychol., Monograph Supplement, No. XIX, 1935.

³ Stephenson W.—(i) *Tetrad Differences for non-verbal tests,*
(ii) do for verbal tests,
(iii) do for verbal subtests relative to non-verbal subtests,

J. Educ. Psychol.—22—pp. 167-85, 255-67, 334-50.

⁴ El Koussy A. A. H.—'The Visual Perception of Space'—Brit. J. Psychol., Monograph Supplement, No. XX, 1935.

⁵ Thurstone L. L.—'Primary Mental Abilities'—Psychometric Monograph, Chicago, 1938.

spatial ability,
 perceptual speed,
 numerical ability,
 verbal relations ability,
 word fluency,
 memory
 and reasoning
 (inductive and deductive).

He claimed to have established the independent existence of all the primary abilities. These abilities were primary in the sense that they were basic to the functioning of an individual and they were *independent* in the sense that they could enter separately or jointly into any functioning of an individual.

Thurstone's theory is obviously of far-reaching implications. Instead of only one 'general intelligence' or one 'g' factor plus a few broad group factors, we have now to take into account as many as seven independent abilities and to make a relative *estimate* of all those abilities of an individual while making any prediction about his possible achievement in a particular area of study or work.

The Sampling Theory:

Another group of psychometricians, headed by Godfrey H. Thomson, hesitated to approve of any of the above theories. The group advocated another new theory, the "*Sampling Theory*", of ability which would attempt to explain all individual functionings in terms of interactions between innumerable traits or factors. They would say that it might be due to mere chance or accident (as in sampling) that a particular pattern or structure had evolved. Fleming, in a different context, uses a sentence which neatly summarised this point of view. "Mind is a rich, comparatively undifferentiated complex of innumerable influences".² This sampling theory, perhaps, reminds us of the 'anarchic' theory of the connectionists (p. 21), just as Thurstone's theory of

¹ Thomson G.—*The Factorial Analysis of Human Ability*. University of London Press Ltd. 1951, p. 307-28.

² Fleming C. M.—*Adolescence* Routledge, Kegan Paul & Co. (1948). Chap. X, p. 128.

Primary Mental Abilities would readily bring back to our mind the image of the 'oligarchic' theory or the Faculty School (p. 20).

Spearman and Thurstone:

When Spearman and his followers recognised the existence of a few broad group factors in addition to 'g' or general mental ability, and when Thurstone in his subsequent findings recognised the existence of a second order 'g' factor over and above his primary mental abilities, the two major schools of thought came almost half way to meet each other. The following lists¹ of mental abilities, one of Thurstone and the other of Holzinger and Harman (the disciples of Spearman) would look almost the same.

	<i>Thurstone</i>	<i>Holzinger & Harman</i>
	Spatial	Spatial
	Perceptual Speed	Imagination
Primary Mental Abilities	Number	Broad
	Verbal Relations	Group
	Word forms	Factors
	(Fluency)	Completion
	Memory	(Verbal)
	Reasoning (Induction and Deduction)	Memory
	Second order 'g' factor	Logical Reasoning (Analogies)
		Rhythm
		General factor 'g'

The real difference, however, lay in the mode of approach, in the attitude towards the solution. While Thurstone and his followers would go to maximise the importance of the 'Primary Abilities' and minimise that of the second-order 'g' factor, Spearman's followers would do almost the reverse, that is, they would maximise the importance of 'g' and minimise that of the broad group factors.

Anyway, had there been a 'halt' at this stage, one might have tried to reconcile the above two theories. But that was not to be. In the American field of psycho-

metry, the list of factors or primary abilities went on expanding and expanding. Shartle and Guilford, after their long experimental work connected with the U.S.E.S. (United States Employment Service) and the U.S.A.A.F. (United States of America Air Force) respectively came up, in 1945 and 1947, with the following factors:—

U.S.E.S. (Shartle) 1945 ¹	U.S.A.A.F. (Guilford & Davies), 1947 ¹
Spatial	Spatial Relations I, II & III
Perceptual (Symbol perception and space perception)	Visualisation
Numerical	Mechanical Experience
Verbal	Perceptual Speed
Memory	Length Estimation
Logical Reasoning	Numerical
	Mathematical Background
	Verbal
	Paired Associate Memory
	Visual Memory
	Picture Word Memory
	General Reasoning
	Analogic Reasoning
	Sequential Reasoning
	Judgment
	Planning
	Simple Integration
	Complex Integration
	Adaptive Integration
Speed	Psychomotor Speed
Aiming	Psychomotor Co-ordinations
Finger Dexterity	Psychomotor Precision
Manual Dexterity	and a few others.

In a recent American review² the following factors have been shown to be fairly well-established in the currently-used tests of ability obtaining in the U.S.A.

(a) Verbal Comprehension (b) Numerical Facility

¹ Super Donald E.—*Appraising Vocational Fitness*, Harper and Brothers, 1949, p. 63.

² Monroe W.—*Encyclopedia of Educ. Research*, Revised Edition, 1950, Macmillan & Co. pp. 606-07.

(c) Abstract Reasoning	(i) Musical Ability
(d) Perceptual Speed	(j) Artistic Ability and a few 'psychomotor' factors like Finger Dexterity,
(e) Word Fluency	Psychomotor Co-ordination
(f) Rote Memory	Aiming, etc.
(g) Spatial Ability	
(h) Mechanical Ability	

We hear too of a number of very complicated 'multi-factor' tests which seek to measure all these abilities (p. 30 afterwards). But how did the British psychologists react to these American developments in 'factor analysis'?

Burt's Hierarchical Structure :

Burt, after a thorough survey of the experimental work done in the field, suggested the following *structure of human abilities*¹ :

- (a) 'g' (the comprehensive general factor covering all cognitive abilities).
- (b) Broader groupings on the higher *relational* level, e.g. apprehension of relations, combination of relations, aesthetic processes and general processes like 'speed' and 'attention'.
- (c) Broad group-factors on the intermediate *associative* level, covering different activities classified according to form or content :
e.g. Memory, Productive Association, Imagery, Verbal Ability, Arithmetical Ability, Practical Ability.
- (d) Some narrower group-factors arising out of differentiation of the broad group factors mentioned above, e.g. practical ability differentiated into spatial and mechanical factors; verbal ability differentiated into word and language factor and so on.
- (e) Narrow factors at the 'perception' level, e.g. perceptual ability, motor speed, etc.
- (f) Factors at the lowest 'sensation' level, e.g. the factors involving the simple sensory processes.

The whole structure would thus appear to be organised in the form of a hierarchy, consisting of a

¹ *Brit. J. Educ. Psychol.*—XIX, 1949, pp. 100-11 and 176-99.

number of successive levels, the factors at the lowest level being the most specific as well as the most numerous. This is Burt's famous hierarchical structure of human abilities.

Vernon's Stand :

Vernon, enriched with the experience of 'follow-up' studies done in connection with the selection of personnel in the British forces follows the middle of the road. Though committing himself to a *hierarchical* rather than a *multiple-factor* view-point, he warns us that the hierarchical principle should not be regarded as exact; there are good grounds for suspecting the existence of minor group factors, either cutting across the groupings or even outside the hierarchy. According to him, the intellectual and practical abilities of human beings can be patterned as follows¹ :

- (a) 'g' (general mental ability)
- (b) v : ed group and k : m group
- (c) (i) v : ed group subdivided into rote memory, verbal ability, logical reasoning, attention, numerical ability, etc.
- (ii) k : m. group subdivided into mechanical information, physical and aesthetic ability, psychomotor co-ordination, spatial ability, etc.
- (d) Subdivision of some of the broad factors [of category (c)] into narrower sub-factors e.g. rote memory subdivided into visual, paired associate or digit memory; psychomotor co-ordination subdivided into motor speed, aiming, finger dexterity and so on.
- (e) Cross cutting the two main groups of v : ed and k : m, a few factors are there which may be described as belonging to the 'speed' group i.e. speed at easy motor and mental operations e.g. perceptual speed, motor speed, word fluency, ideational fluency, clerical ability, etc.

* * * * *

Studies in the analysis of human mental endowment

¹ Vernon, P. E.—*The Structure of Human Abilities*, Methuen & Co., London, 1950, p. 85.

are still going on and it is not perhaps possible to say at this stage how many abilities there are or what abilities should be considered as more important than others. One may feel that the number of '*distinct and important*' abilities is rather large and that we are justified in assuming that individuals differ amongst themselves with respect to these abilities. It is, perhaps, a matter of belief whether we treat these abilities as more or less independent of one another or they are shown to form certain broad groupings or clusterings in a connected whole.

We have also reasons to suppose that if we can find a satisfactory way of measuring these abilities, we may expect to get a very useful picture of the individual we would like to guide.

We discuss, in the next section of this chapter, the practical implications of developing tests for the measurement of these abilities. Technical discussions on the recent developments in factor-analysis together with the contributions and limitations of the 'factor-analysis' methods are, however, placed in appendix A.

B. PRACTICAL IMPLICATIONS

From the standpoint of testing, the conflicting theories of human abilities (as described in the previous section) resulted in the development of diverse types of tests.

Types of Tests Developed :

The advocates of the single factor theory would always go in for a test of 'g' or general mental ability; whereas the supporters of 'multiple factor' theory would always clamour for a series or 'battery' of tests to measure the primary abilities or mental factors. Thorndike's concept of 'abstract' 'mechanical' and 'social' intelligence (vide p. 22 ante) culminated in the development of three types of tests of distinct nature. Similarly some non-verbal tests of the 'performance' types were developed to assess an individual's ability to solve 'concrete' problems as against the 'verbal' ones. Some, again, tried to bring about a compromise between these conflicting schools of thought by developing tests which would yield, for every individual, a 'total score' indicative of his 'g' or general mental ability as well as some 'part-scores' (like verbal score, performance score, quantitative score, etc.) indicative of his 'abilities' in different types or areas of activity. For example, a test is developed with two or three parts, containing verbal or numerical items or items of the object-assembly type. The scores on these parts taken separately are interpreted as indices of one's verbal, numerical or performance ability (as the case may be), whereas the total score on the test (as a whole) is taken to be indicative of one's general intelligence.

Recently the experimental findings of Guilford & Davies and Shartle have induced the American teachers to make increasing use of the long batteries of tests like the Differential Aptitude Tests, the General Aptitude Test Battery, Guilford Zimmerman Aptitude Survey, etc.¹ for the purpose of prediction and guidance.

In Britain, in the selection of children for different types of secondary education, there is, usually, a test of

¹ *Personnel Guid. J.*—A.P.G.A.—Washington, D.C. September, 1956—September, 1957.

general intelligence supplemented by a few tests of the broad group-factors like verbal, arithmetical, practical, spatial, mechanical, or even a few tests of perceptual speed, clerical ability, etc. (Burt and Vernon).

General Intelligence vs. Differential Abilities :

Opinions differ in regard to the usefulness of having a test-programme of this or that type.

It is now being increasingly recognised, even in England, that single or 'global' intelligence test score, though fairly useful for general predictive purposes in educational or vocational fields, does not, or rather cannot, give anything more than a very broad indication of the over-all mental level of the individual. In other words, the individual's general intelligence score only helps us to determine the *average level* of education for which he is suited ; but it does not differentiate between *types* of ability. Two persons having the same 'general intelligence' score (global score) may show, or rather do usually show, marked differences in their mental make-up. For that reason some educators and psychologists of the present day suggest that at the time of allocation of pupils at 13 plus or 14 plus, to different types of secondary education, the use of 'factor' tests should be encouraged. They believe that abilities tend to become more and more specialised and differentiated with diversified experience at the higher age and that assessment of these differentiated abilities would, therefore, be more useful.

Most of the American psychologists who favour the idea of testing the differential abilities of the individual believe that the factorial approach to mental testing enables them to gauge and evaluate the abilities of man rather widely, adequately, meaningfully and economically. Their belief has been considerably strengthened by evidences accumulated during the second world war.

But many British psychologists and educationists do not favour this American approach. It has been remarked in the report of the National Union of Teachers (1949)¹ that the psychologists who appeared before them were

¹ National Union of Teachers (England) Report on "Transfer from Primary to Secondary Schools", 1949, pp. 40-41.

unanimous in their scepticism as to the psychological reality of the 'aptitudes' implied by the tests. The general opinion is that successful performance in such tests is determined largely by interest and experience and that it is susceptible to rapid variation under educational influence. "On the more practical point as to whether these tests yield results significant for purpose of selection or allocation, the most favourable view that has been expressed is that a significant result is obtainable from a small proportion of children at 11 plus and that the proportion is somewhat larger, but still small, at 13 plus....."

Stephenson¹, however, describes the American educational scene as more truly democratic, more tolerant, more in keeping with the psychological facts, more adequate socially, than any other system.

Morrisby, of the Department of Psychology, University of Leeds, also stresses the need for differential testing as it helps one to see "the nature of a person's mental-ability-structure in perspective, in the round".²

Our Approach :

At this point of our discussion, we should not commit ourselves to any one of these views. We shall be in a much better position to judge the kind of test or test-programme that we should develop when we have analysed our requirements in a little more detail. We are trying to choose for our pupils the type of courses in which they are likely to do better. In other words, we are interested in differential prediction i.e. prediction of relative achievement of pupils in different courses of multilateral education.

We may be tempted to direct our programme for ability-testing more and more towards progressive differentiation of abilities. But let us be practical to discuss, first, the nature of correspondence between human-variations and diversified courses at the secondary stage.

¹ Stephenson, W.—'Testing School Children', Longman Green & Co. 1949, p. 11.

² Morrisby, J. R.—'The Differential Test Battery'—N.F.E.R. Bulletin No. 6, November, 1955, p. 27.

CHAPTER V

Diversified Courses and Human Variations

We have discussed in the previous two chapters our first major assumption that the individuals differ amongst themselves in respect of abilities or mental factors. We now come to the second assumption, namely, the diversified courses introduced at the secondary stage are adequate enough to meet the diverging needs of the adolescent. In other words, we are now to examine if ability-differences among individuals are usually of such a nature that provision of diversified courses (elective groups of subject) at the higher secondary stage would come out as one of the practicable ways of attaining the central objective of education, i.e. the development of one's potentialities to the fullest extent possible. Of course none of these elective-groups should be thought of as having merely the specific goal of acquiring certain types of skill and knowledge. Each one of them should rather be regarded as alternative bias in the curriculum superimposed on a common 'core' for the 'total education' of an individual.

On the face of it, these elective-groups may appear to be quite distinct from each other and may, consequently, demand different types of ability for the pupil to be successful. But do these 'electives' really involve distinctive biases from the point of view of 'abilities' so that children with the corresponding bias may be easily advised to select appropriately one 'elective' group or another? This is undoubtedly a big query.

Choice of Electives :

The choice of electives, as we know, always troubles most of the students in higher education. Sometimes the choice is made quite haphazardly and on the spur of the moment, because of some passing or irrelevant fancy, superficial interest, admiration for a parent or other influential relatives, or even for the teacher. Sometimes,

again, selection of a course-group, is unduly influenced by the casual advice of a friend, cursory suggestions of a well-wisher or even the ephemeral attractiveness and scorability of the subjects included in the group. As a result, many of the students regret the choice later in their educational or occupational career. Could we help these unfortunate students in their early life? One would very much like to do that. But how can we help? Is there any possibility of making the choice of 'elective' subjects more soundly-based, objective and scientific? Can we demonstrate that there are different patterns of abilities corresponding to the different subject-groups of the diversified curricula? A few researchers in education have, of late, concentrated their attention on this complex problem of *differential prediction*. Differential prediction, as the very term would imply, demands that we should try to determine beforehand, as scientifically as possible, the particular course-group (or job) which would fit an individual's ability-pattern in the best way.

Nature of Investigations :

Investigators in the field usually undertake the following two types of studies for the solution of the problem.

(i) *Follow-up study* : Here, the individual members of a group, at a particular stage, are first described in detail with reference to an agreed list of traits or abilities and then, they are *followed up* steadily through their careers in schools or colleges and even through their occupational life. The general pattern of the measured abilities of a number of individuals (of that 'followed up' group) whose satisfactory achievement in respect of a particular type of *course* or *work* is considered to be very *encouraging*, is, thereafter, taken to be the criterion for that type of *course* or *work*. That is, in future, individuals showing similar pattern of measured abilities at the same stage of their life may be advised with some degree of confidence to take up that type of *course* or *work*.

(ii) Cross-sectional study :

Here, individuals belonging to different types of courses or jobs and who have made satisfactory progress are analytically described in terms of an agreed list of

traits or abilities and the general pattern of measured abilities or traits, evinced by each section of the group studied, is then taken as the criterion for the corresponding type of course or job. When, on future occasions, a student shows a pattern of abilities similar to that of a particular section, he may, with some degree of confidence, be advised to go in for that type of course or job.*

It must, however, be realised that, in both these studies, the difficulty of discovering the proper *criterion* is very great. How are we to decide which individuals made satisfactory progress? What should be our means of assessment? Any defect or short-coming here, i.e. in our means of assessment, is likely to vitiate all our subsequent findings.

Naturally, then, this part, the assessment of pupils' achievement in schools and colleges or the rating of workers in firms or factories or offices, needs greatest emphasis for significant improvement. It is really unfortunate that the few investigators who wanted to do something in this regard were frequently faced with difficulties of the following type :

- (a) Unreliability of school (or college) marks and/or grades or supervisor's ratings.
- (b) Variation in the departmental standards or procedures of assessment.
- (c) Individuals with varying levels of ability (or abilities) being attracted to different courses of study and training or to different types of jobs, under the prevailing socio-economic conditions of the society.

In spite of these difficulties, a few such investigations appear to offer a promising lead.

In 'selective' types of educational system, like the one we find in England, the following principles have so far been found to work more or less satisfactorily :

- (i) Higher levels of school-attainment plus higher degrees of *abstract* intelligence (of the type of general mental ability) suit well for the tradi-

* The technical methods that are normally recommended for the purpose of such studies are described in Appendix B.

tional grammar school curriculum (arts and science).

- (ii) Higher (or even average) levels of attainment together with higher degrees of 'practical ability' correspond fairly satisfactorily to the requirements of higher types of technical education.
- (iii) Average attainment plus average intelligence may fit one for other types of secondary course, namely, commercial, fine arts, etc.
- (iv) Lower levels of attainment together with lower degrees of intelligence may be connected with the ordinary modern school course which is directed towards the development of a vocational bias through practical training.

Super¹ maintains that different curricula have been found to require and/or to attract different degrees of general mental ability, both at the high school and at the college level. Students in scientific and liberal arts courses usually score highest in the 'general intelligence' tests, students in commercial subjects figure next while those in the ordinary trade-courses come out last.

But there are people who doubt the validity of such principles. They feel that a single (or global) measure of general mental ability together with measures of attainment in two major subjects like mother language and arithmetic cannot help us make differential estimate of one's success in the diversified courses introduced at the same level or stage.

Course-groups and Human Types :

On what other basis, then, can we justify the grouping of a number of subjects into a course, for specialised study by individuals endowed with corresponding ability or abilities? How can we claim that groupings of a number of subjects into broader areas with corresponding mental trait or traits predominantly influencing successful achievement in them are fairly well-established? Or, should we take the opposite stand and say with Dr.

¹ Super Donald E.—*Appraising Vocational Fitness*—Harper and Brothers, 1949, p. 87.

Fleming¹ that all adolescents are capable of developing satisfactorily by continued education of a widely diversified type?

Some maintain that bonds of connection could be discovered between groups of school subjects, which represented abilities of more or less specified character and in respect of which there were marked differences among individuals.²

The school achievements in different subjects have been shown to form distinct clusters like linguistic, mathematics-science, spatial-mechanical and fine arts.^{3, 4, 5}

It has been suggested that there are differential mental abilities for different courses of the following type :^{6, 7}

<i>Course-group.</i>	<i>Mental abilities.</i>
(i) Liberal Arts study.	{ (a) Verbal facility. (b) Linguistic Aptitude.
(ii) Pure Science and Mathematics.	{ (c) Verbal Reasoning. (d) Quantitative Reasoning. (e) Mathematical Aptitude.
(iii) Applied Science, Engineering and Technology.	{ (f) Spatial-visualisation. (g) Mechanical Ingenuity.

Some would hint at the following subject-groupings with a few overlapping influences in-between them :⁸

(a) Literature, language and other verbal subjects.

(b) Branches of Mathematics.

¹ Fleming C. M.—*Adolescence*—Routledge and Kegan Paul, Ltd., 1948, Chap. X.

² Earle F. M.—*Tests of Ability for Secondary School Courses*—University of London Press, Ltd., 1936, p. 36.

³ Kerr George—*Aptitude Testing for Secondary Courses*—Occup. Psychol. 16, April 1942, pp. 73-78.

⁴ Dempster J. J. B.—M. A. Thesis, Univ. of London, 1944.

⁵ King W. H.—Ph.D. Thesis, Univ. of London, 1949.

⁶ Crawford A. B.—*Individual Difference in Educational Guidance*—Psychol. Monograph, 47, No. 2, 1936, pp. 148-72.

⁷ Crawford and Burnham—*Forecasting College Achievements*—Yale Univ. Press, 1946, pp. 136-38.

⁸ Vernon P. E.—*The Structure of Human Abilities*, Methuen and Co. Ltd., 1950, p. 47.

- (c) Scientific subjects.
- (d) Technical subjects.
- (e) Aesthetic subjects including drawing.

Some, again, would suggest¹ that the most natural groupings of pupils in a school-class may be done as per the following scheme :—

<i>Ability.</i>	<i>Field of highest manifestation.</i>
(a) Ability of verbal comprehension (V).	The Humanities.
(b) Ability to produce verbal images fluently and abundantly (W).	Literature.
(c) Ability to solve quantitative problems (R).	The Exact Sciences.
(d) Ability to produce quantitative images fluently and abundantly (N).	Music.
(e) Ability to solve concrete visual problems (S).	Technology.
(f) Ability to produce visual images fluently and abundantly (P).	The Fine Arts.

Do these investigational claims point to anything concrete? One would, perhaps, find some clues therein to the provision of the following course-groups in the diversified curricula.

- (a) Literature and the Humanities.
- (b) Mathematics and Science.
- (c) Technical-Mechanical.
- (d) Fine Arts including Music.

Even if we admit that these four 'courses' are possible and practicable from the standpoint of the nature and structure of mental abilities, should we venture into this complicated project of diversified courses simply on the strength of the findings of 'ability-testing'? Do we feel that 'abilities' alone should be considered in this regard? Does 'ability-testing' tell us everything about the psycho-

¹ Ahmavaara Y.—*Transformation Analysis of Factorial Data*
University of Helsinki, 1954, p. 107-08.

dynamics (of an individual) which combine together to determine the direction of his future development? Even if abilities are taken to be the most important factors in the life of an individual, what guarantee is there that the full realisation of these abilities will be reached in early or late adolescence? If, again, these 'abilities' turn out to be "more responsive to subtle environmental influences in early years than is yet generally conceded"¹, will not these so-called 'natural regulators' be reduced to mere 'instrumentalities' within our control? These are all disturbing queries that further complicate the problem and consequently deepen our responsibilities.

And, then, what about 'Interests' or 'personal preferences' of an individual? Many would like to stress the importance of 'interest' in a vital issue like this. Are there different types of human interests as there are differential abilities? Even if there are, do these differentiated areas of interest properly correspond to the different streams of the diversified curricula?

If we try to make a synthetic survey, as has been done by Super², of the various 'interest' factors brought out by the works of Thrustone, Allport and Vernon, Lurie, Strong, Kuder and Lambert, we may reasonably distinguish between the following areas or types of interest.

- (a) Literary-academic
- (b) Scientific
- (c) Mechanical-technical-concrete
- (d) Social service-human welfare
- (e) Clerical-computational (Business-economic)
- (f) Persuasive (Business-political)
- (g) Artistic
- (h) Musical and
- (i) Religious.

Course groups and Psychological Findings :

When we look into the above list we find that four streams of our diversified courses, humanities, science, technical and fine arts, may be reasonably associated with four types of interest, e.g. literary-academic, scientific, mechanical-technical-concrete and artistic-musical respectively.

¹ The Journal of Education, London, 89, No. 1051, February, 1957, p. 48.

² Super Donald E.—*Appraising Vocational Fitness*, Harper and Brothers, 1949, p. 38.

tively. Earlier we have shown that these four streams may also be justified from the standpoint of abilities. Analysis of the interest-factor, therefore, does not go against that classification. Can we, then, say with some amount of confidence that these four streams of multi-lateral education are possible and practicable? What about the other three,—commerce, agriculture and home science? Perhaps, we may justify the commercial stream, on the strength of the *clerical ability* ('q' factor) on the one hand and clerical-computational (business-economic) interest on the other, both of which correspond to it at least partially. The remaining two streams of agriculture and home science still go unexplained. No such evidence of their corresponding ability and/or interest pattern is readily available. Or, should we say that these two streams are mostly conditioned by our sociological requirements and not by our psychological needs?

Some might even go so far as to suggest that each one of these diversified courses is sociologically or culturally conditioned and that we are, perhaps, guilty of 'rationalisation' when we try to probe into their psychological bases and substantiate them on psychological grounds. We fail to come out with anything particular in case of the two courses of agriculture and home-science, simply because they are relatively new and recent in the field. Given some time for these courses to consolidate and get a little older to influence our culture, we may reasonably expect to have these areas also duly reflected in our mental testing. [Vide Ahmavaara's 'hypothesis of parallelism'.¹]

In fact, many such discussions on the problem of relationship between the diversified courses and variations in human nature often become so emotionally loaded that they usually produce more heat than light. There is still a tendency in many quarters to maintain a socially (and also psychologically) untenable approach. *Differentiation* seems to be regarded mostly as a simple procedure for selecting and segregating pupils at an early age whereas,

¹ Ahmavaara Y.—*Transformation Analysis of Factorial Data*, University of Helsinki, 1954, p. 107-08.

differentiation and individualisation are primarily problems of providing varied but well-balanced educational opportunities needed by the individual and the society. The young learners themselves are to be guided and directed in their process of differentiation and concentration through wise selection among the opportunities that are or should be provided.

CHAPTER VI

Pupil-Guidance in the United Kingdom*

Before we start discussing the practical plan of work for our country, it would be profitable for us to know something about the guidance programme of the United Kingdom.

There are, as we know, three main types of secondary schools in the United Kingdom :—†

- (i) The grammar schools which provide a sort of 'liberal' education with a predominantly academic curriculum prepare pupils mostly for university education.
- (ii) The technical schools which furnish technical, art and commercial courses prepare pupils for apprenticeship in industry and commerce and also for technical colleges.
- (iii) The modern schools which most children leave at 15 provide a *general* course of practical nature.

Prior to the Education Act of 1944, English educators were mostly interested in the problem of selecting students for the Grammar, Technical and Modern Schools of the tripartite system of Secondary Education. But in the Act of 1944, it has been clearly laid down that the Local Educational Authorities, in their respective areas, must provide such educational facilities as would 'afford for

* This section was published in the form of an article in the *Journal of Vocational and Educational Guidance (India)*, Vol. 5, No. 4, May 1959.

† Quite recently we hear of a fourth type of secondary school, the 'Comprehensive' schools. They are "non-selective in their intake of pupils" and they provide more opportunities for individual choice of courses.

all pupils opportunities for education offering such variety of instruction and training as may be desirable in view of their different ages, abilities and aptitudes, and of the different periods for which they may be expected to remain at schools, including practical instruction and training appropriate to their respective needs'.¹ It has also been stated that these objectives of the re-organised Secondary Education can be adequately achieved and the resulting duties properly discharged, only by an authority which provides appropriately differentiated educational courses and which, at the same time, *takes every step it can to improve the methods of assessing the potentialities of individual children*. Educational guidance, universal and continuous, has thus been clearly and definitely charged on the English educational authorities, as an inescapable duty.

The Guidance-Problem Analysed :

The problem involved being complicated and technical, a separate organisation, the National Foundation for Educational Research in England and Wales, has taken them up and has been trying, since its establishment, to meet the pressing needs of educational guidance, namely, devising correct methods of approach (i) to cover different aspects of the problem, (ii) to tap all possible sources and (iii) to utilise as much of the evidence of an 'objective' nature as practicable.

The tools and methods used so far to select pupils for different types of secondary Education have lately been subjected to hard but legitimate criticism. We may summarise some of the important suggestions made by leading British educators and psychometricians to modify and supplement the selection programme :

Eysenck² suggested that—

(a) School records or special achievement tests combined with intelligence tests might predict subsequent achievement in higher education with considerable accuracy.

(b) A questionnaire covering personal background

¹ The Education Act 1944, H.M.S.O. London, 1944, Section 8.

² Brit. J. Educ. Psychol. XVII, 1947, pp. 20-39.

and details of past history as well as an interest-questionnaire might be helpful when added to other types of tests.

Burt¹, stated that an ideal plan of allocation should be based not merely on tests of the child's abilities, aptitudes and attainments, but (as far as possible) on his whole personality and sociological background. He added that, on the basis of existing knowledge, psychological considerations were probably less important than non-psychological ones (e.g. the need of the community and the locality, the practical difficulties of providing special types of schools or multilateral schools in any area, parental bias or prejudice about different types of education, the actual occupation likely to be available for children after completion of education, etc. etc.)

Alexander², from an administrator's point of view, stated that allocation should be based on the child's abilities, aptitudes and attainments, together with assessments of the more important character-traits, such as persistence, emotional stability, etc. and in the general light of the cumulative record in schools, with special reference to the health-factor.

Bradford³ looked at the problem from an experimenter's standpoint and while discussing the test programme (including tests of fundamentals in English and Arithmetic, a test-battery equally balanced between verbal and non-verbal tests together with a practical test) stated that (i) candidates with a high average and no marked bias should be given priority of allocation and freedom of choice, (ii) biased candidates with equally high average should be given next priority but subject to the direction to a grammar or technical schools, with the option of refusal only. He put much stress on the *revision of initial allocation* being a routine procedure, because, according to him, the selection procedure should always be *impartial*, even if somewhat *inaccurate*.

¹ *Brit. J. Educ. Psychol.* XVII, 1947, pp. 57-71, and XX, 1950, pp. 1-10.

² *Brit. J. Educ. Psychol.* XVII, 1947, pp. 123-30.

³ *Brit. J. Educ. Psychol.* XVIII, 1948, pp. 67-86.

Dempster¹ suggested that selection for grammar and technical education might be done effectively as per the two trends of mental ability, abstract-verbal and concrete-spatial. He, however, felt that some improvements should be made in the procedure for test administration and the methods of recording teachers' reports. He also stressed the need of developing a suitable form for the consolidated presentation of all the available data about the child. In his later investigation², however, he doubted the usefulness of verbal and spatial test alone for discrimination purposes.

Peel stated³ that greater efficiency would result from the inclusion of 'practical ability' tests in the selection programme.

Lambert⁴, while advocating the use of an interest test as part of the selection-criteria, hinted at the probable existence of the following three types of children:—

(a) Children of grammar-school-ability with a significant bias of verbal ability and academic interest.

(b) Children of technical-school-ability with significant bias of practical ability and technical interest.

(c) Children of no definite bias in any particular direction.

In a later investigation⁵ Lambert suggested that the initial selection, for higher education, should be done on an all-round bias, according to the results of intelligence test (verbal and non-verbal) plus tests of English and Arithmetic. It might be possible, thereafter, to increase prognosis for different sections of the curriculum (e.g. English and French, Mathematics and Science or Art and Wood-work) by the use of the results of additional tests, such as performance tests, interest tests, etc. She also suggested that provision for easy transfer from one stream to another should be made.

Rodger, from the standpoint of an industrial psycho-

¹ *Brit. J. Educ. Psychol.* XVIII, 1948, pp. 121-33.

² Dempster J. J. B., Ph.D. Thesis, Univ. of London, 1951.

³ *Brit. J. Educ. Psychol.* XIX, 1949, pp. 115.

⁴ *Brit. J. Educ. Psychol.* XIX, 1949, pp. 67-79.

⁵ Lambert C. M. Ph.D. Thesis, Univ. of London, 1952.

logist¹, touched on the similarities between the two problems of arranging a good secondary school allocation scheme and a good vocational guidance scheme and suggested that the school record card should include items which would be of great value towards subsequent vocational guidance for school leavers.

From all these discussions and investigations one can manage to get a fairly good idea about the principles and techniques in the field of selection and allocation in the secondary schools of the United Kingdom.

Practices in Schools :

Apart from these, actual visits to the schools would also help one collect some very useful information about the practical procedures of transfer to different courses of secondary education at the age of 13 plus. After the initial selection at the end of junior school stage, the pupils of a modern school are given at the age of 13 plus another opportunity of being transferred to technical, commercial and art courses of secondary education, or even to the G.C.E. (General Certificate of Education) stream, provided they or their parents so desire and they are found to be suitable for the purpose.

Such transfers, or the recommendations for such transfers, are usually made on the basis of the following sets of data, collected about the pupils from different sources.

I. *From the Junior School Record.*

- (a) Scores on Intelligence, English and Arithmetic tests, in the qualifying examination at the end of the junior school stage.
- (b) Interest.
- (c) Activities.
- (d) Personal characteristics.
- (e) Teachers' estimates.

II. *From the Internal Record of the School.*

- (a) Medical report.
- (b) School examination results or terminal reports on—

¹ Brit. J. Educ. Psychol. XIX, 1949, pp. 154-59.

- (i) English and Arithmetic Specially considered for commercial courses.
- (ii) Geometrical drawing, Craftsmanship, Wood-work, Metal work. Specially considered for technical courses.
- (iii) Art, Craft, Handicraft, Needle-work, Drawing. Specially considered for art courses.
- (c) Teachers' (Form-masters') recommendations (In case of schools providing the courses themselves, recommendations of the sectional heads).

III. *Parents' Wishes.*

In some cases, however, pupils at 13 plus are classified by the heads of the secondary modern schools into four streams on the basis of the qualifying (i.e. 11 plus) examination results and transfers are usually recommended (other data being duly considered)—from the *top streams* for the G.C.E. course and from the *two middle streams* for technical and other courses of secondary education. Pupils of the *bottom streams* generally complete the ordinary modern school courses.

Sometimes again, a new test-battery is administered to the candidates at 13 plus and selection is made for the three courses, technical, commercial and art, on the basis of its findings. Experiments are still being conducted to develop the test-battery in such a way that pupils' potentialities and interests for the different courses may be rightly indicated.

Work of the Research Organisations :

Last, but not least, comes the working of research organisations like the National Institute of Industrial Psychology and the National Foundation for Educational Research in England and Wales, where one can acquire a very fruitful and effective knowledge of the actual guidance facilities extended to the students and the youth of the country.

N.I.I.P.—The well-developed programme of vocational guidance at the National Institute of Industrial Psychology contains valuable hints towards solving the intricate problem of educational guidance. As Burt puts it¹ "The classification of pupils for literary, scientific, technical and other forms of specialised education is as much a matter of vocational as of educational guidance." Rodger has also remarked² that a good programme of educational guidance at the secondary stage would bear great resemblance to a good scheme of vocational guidance.

The normal procedure followed at the Institute consists of the following phases :

(a) *Completion by the parent or guardian of a fairly extensive biographical record-form :*

(The form is intended to give some basic factual information about the candidates, specially some of their dispositional qualities and interests).

(b) *Completion of a report by authorities of the school, attended by the candidates.*

(The report covers their achievements and aptitudes).

(c) *Psychological testing of the candidates.*

The test programme includes the following :

(i) Intelligence (verbal and non-verbal).

(ii) Special abilities e.g. spatial, mechanical, practical, clerical, etc. (both in individual and group form).

(iii) Attainment in Elementary Mathematics.

(iv) General Information.

(v) Some Personality Traits (when required).

(d) *Interview :* Two interviews are taken separately by two advisers. Attempts are made (i) to supplement,

by these interviews, the information already collected through record forms, mentioned before, and (ii) to assess *personality traits*, (like leadership, initiative and self-confidence) *intellectual and social traits* (such as mode of approach to work or method of work, e.g. logical, systematic) and *personal attitude* (like emotional stability, objectivity), etc.

¹ *Brit. J. Educ. Psychol.* XIII, 1943, pp. 126-40.

² *Brit. J. Educ. Psychol.* XIX, 1949, pp. 154-59.

(e) *Summary and recommendations.*

A summary of each case is made on a record sheet designed to carry, in a compact form, all the essential information about the candidate and thereafter notes of recommendations are appended to it.

(f) *Discussions with the parent or guardian about the findings and the nature of recommendations made thereon.*(g) *Final 'orientation' interview with the candidate.*

N.F.E.R.—The National Foundation for Educational Research has undertaken a number of 'studies' in connection with the allocation programme for primary school leavers. The bulletins and other publications of the Foundation are intended to give their readers a fairly broad idea about its activities. Some of these bulletins contain valuable materials of both theoretical and practical interest.

In the first interim report of 1950, much emphasis has been laid on the continuous improvement of the existing tools of allocation as well as on the need for identifying and assessing some of the non-examinable qualities of character and disposition and also for recording parents' wishes, children's likes and dislikes, socio-economic factors, hereditary occupations, etc. for the purpose.

The crucial issue of setting up the minimum level of ability, attainment and desirable personality traits for initial allocation, has also been raised along with the question of the 'criterion' to be used for gauging the value and efficiency of the guidance programme as such.

In the second interim report (publication No. 6) of 1952, various technical issues were discussed in regard to reliability of examinations and variability of pupils' performances.

In the Allocation Studies II of 1952-53, conducted in collaboration with the Middlesex Education Committee, certain interesting revelations have been made in respect of—

(i) the contribution of security, affection and encouragement, enjoyed by the child in its family, towards

determining the child's future success in the secondary school course, and (ii) the importance of teachers' estimates in predicting the child's later performance in a secondary school.*

Our Work-programme Visualised :

In view of what has been stated above,—the views and claims of different psychologists and educators, the actual work-procedures followed in schools and the principles and methods followed at the research centres—one would perhaps envisage an elaborate programme of work to organise the proposed guidance activities in our multi-lateral schools.

The programme should include,—

- (a) a battery of tests comprising tests of general intelligence and tests of special abilities or aptitudes;
- (b) standardised attainment tests of specific subjects (at least, of the major subjects of mother tongue and arithmetic);
- (c) tools for the assessment of interest;
- (d) the school record card, covering the cumulative report of attainment, health, personal history and socio-economic background;
- (e) tools for the assessment of important personality traits;
- (f) teachers' estimates and recommendations;
- (g) a consolidated report in suitable form on each and every individual.

Other important questions, like removal of parental as well as public bias, facility for revision of initial allocation, availability of suitable schools and/or employment after training, should also be duly considered.

As Alec Rodger¹ has put it, all possible attempts should be made to make the scheme *technically sound, administratively convenient and politically defensible*. It

* The writer is indebted to both these organisations, the N.I.I.P. and the N.F.E.R. for allowing him the privilege of going through most of their work-materials as well as of discussing the matter with their senior officials.

¹ *Brit. J. Educ. Psychol.* XIX, 1949, pp. 154-59.

should, however, be admitted that a useful blending of these desirable qualities is by no means an easy affair. It would entail more than what Lowndes had described as the "peculiarity of British character with its strange fusion of Celtic imagination, Anglo-Saxon practicality and Norman flair of administration."¹

¹ Lowndes G. A. L.—*The British Educational System*—Hutchinsons Univ. Library, London, 1955, p. 93.

CHAPTER VII

The Test Programme

We pass on, now, to our third assumption (p. 15) and discuss how successful achievement in higher secondary courses depends upon varying degrees and/or patterns of abilities, interests, etc.

As mentioned earlier, our secondary curriculum has two parts, the 'core' and the 'elective' (pp. 6-9). The 'Core' part includes subjects like languages, social studies, mathematics and general science and is intended to further the 'general' education of pupils. The subjects in the 'elective' part are meant for specialised training of an individual in view of his specific pattern of abilities, interests, etc. We have also stated that at the present moment or in the near future only 20 to 25 per cent of the total number of children completing compulsory education at the age of 14 would go on to the higher secondary schools (p. 4), and it will be our task to select those children who are best fit for the purpose.

Naturally, our problem of educational guidance at the higher secondary stage resolves into two major issues :

- (a) First, we are to examine the general suitability of an individual for going on to higher secondary schools. In other words, we are to judge whether an individual is really capable of utilising fairly satisfactorily the opportunities of higher education in the multilateral schools.
- (b) After the first issue is solved to our satisfaction, we are next to examine which one of the seven 'elective' courses would suit the selected individual best, i.e. in which one of the elective groups the individual is likely to attain maximum success for the good of both the individual and the society.

We will discuss these two issues successively in the next two sections of this chapter.

A. SELECTION FOR SECONDARY EDUCATION (GENERAL)
Procedures in a test development programme :

The development of any test programme to meet the requirements of a particular situation should proceed along any one of the following lines :¹

(a) It may be based on the 'work-sample' principle, a direct and expedient step. According to this principle, we are to develop a large number of tests, each representing a particular type of work involved in the area to be investigated. In most cases of personnel selection, the 'work-sample' procedure is usually recommended. From the stand-point of educational guidance, this procedure would result in the development of a long series of tests covering different subjects of the curriculum. The subject-tests thus developed are technically known as "prognosis" tests. But usually it does not appear to be so satisfactory from the point of view of administrative economy.

(b) It may, after a thorough psychological analysis of the related field, be so designed that it would measure specifically those traits which are considered to be relevant and important. There are, however, some difficulties along this line. Sometimes the trait-contents of different areas are found to be confusingly overlapping or hazy in contour.

(c) It may be processed as per the modern technique of 'factor-analysis' which is acclaimed to be the most satisfactory method from the standpoint of precision, reliability, meaningfulness and economy. This technique, however, demands a lot of preliminary research-work to reach the final stage and, as such, definitely involves a 'long-term' project.

For the sake of expediency, we should, perhaps, recommend the second method. The test-programme, thus devised, may subsequently be properly validated.

Our first task, then, is to determine the principal

¹ Guilford J. P.—*Factor Analysis in a test development programme*—*Psychol. Review* 55, 1948, pp. 79-94.

traits (in terms of single, unitary factors, as far as practicable) which enter into, or contribute significantly towards, pupils' success in higher secondary education.

Prediction of success in general education :

So far as success in 'general education' is concerned, quite a good number of 'factors' or 'traits' may play their part significantly. Let us, however, first deal with the role of 'general intelligence' which is usually stated to be the most important single factor to be considered in this respect. It has become rather a tradition to use a 'general intelligence' test-score for predicting success in higher education. It may, therefore, be profitable for us to see how far and to what extent that practice is justified on the basis of the findings of past investigations related to the issue.

Role of General Intelligence :

So many investigations have been done in regard to the role of 'general intelligence' in higher education that it would be impossible to refer to all of them individually here. Let us summarise them in our own way :

Some of the researchers^{1, 2, 3, 6, 8}, were interested in evaluating the role of general intelligence in high school achievement and they reported the degree of relationship (co-efficient of correlation) between intelligence test scores on the one hand and high school grades or examination marks on the other. The average co-efficient of correlation (*r*) ranged from .40 to .54.

(The value of the co-efficient of correlation, as we know, varies from -1 to +1 through zero).

Some other researchers^{4, 5, 7, 8}, wanted to know the exact

¹ *J. Educ. Psychol.* 13, Oct. 1922, pp. 419-29.

² Pinter R.—*Intelligence Testing—Methods and Results*—University of London Press, Ltd. 1927, p. 256.

³ Monroe W.—*Encyclopaedia of Educational Research*, Revised Edition—1950, MacMillan & Co. p. 880 and p. 882-83.

⁴ *Educ. Psychol. Meas.*—Oct. 1944, pp. 387-98.

⁵ *Educ. Psychol. Meas.*—V. No. 3, 1945, pp. 273-83.

⁶ *J. Educ. Psychol.* 34, April, 1943, pp. 229-36.

⁷ *J. Exp. Educ.* XVIII, No. 2, Dec. 1949, pp. 91-138.

⁸ Super Donald E.—*Appraising Vocational Fitness*—Harper & Brothers, New York, 1949, p. 90.

contribution of general intelligence towards college-success or success in the university examinations. They also found out, for the purpose, the degree of relationship between intelligence test-scores and college grades or university examination results. The average co-efficient of correlation in this case ranged from .30 to .52.

Vernon and Parry came to conclude¹ that the usefulness of 'Group Intelligence Tests' (of the ordinary verbal type) in relation to school and university work was well-established.

Some investigators², again, were bold enough to claim that the general intelligence test-score was the best single predictor for school and college work, in general.

* * * * *

From these evidences, it seems that the importance of general intelligence is, perhaps, universally accepted, at least for the purpose of predicting '*general scholarship*' in high schools and colleges. Our 'Core Curriculum,' at the higher secondary stage, represents most of the subjects usually included in any scheme of 'general' education, e.g. languages including the mother tongue and a foreign language, general science including mathematics and social studies including history and geography.

In order to ensure, therefore, that a pupil would attain reasonable success in subjects of the core-curriculum, we should make provision for a test of general intelligence in the programme. Even though some educators and psychologists claim to have put forward a theory of decreasing importance of the '*general intelligence factor*' in the developing life of an individual, we do not see any good reason why we should not make use of the general intelligence test score to our advantage. Recently Dempster³ and Lambert⁴ have suggested that the general

¹ Vernon and Parry—*Personnel Selection in the British Forces*
—Univ. of London Press, Ltd. 1949, p. 204.

² *Brit. J. Educ. Psychol.*—XXI, 1951, pp. 30-35.

³ Dempster J. J. B.—Ph.D. Thesis, Univ. of London, 1951.

⁴ Lambert C. M.—Ph.D. Thesis, Univ. of London, 1952.

ment' to be so. Consequently, it seems to be a very useful and practical suggestion when some educators recommend the combined use of intelligence test-scores, school marks and/or scores on standardised achievement tests for the purpose. In the U.K. (vide Chap VI) there is always the provision for all the three, i.e. the intelligence test scores, scores on standardised achievement tests of English and Arithmetic and school marks in respect of those two major subjects, though the intelligence test-scores are sometimes given greater weight. A few investigations have also been done quite recently by the National Foundation for Educational Research in this respect. It has been claimed¹ that children with attainment test scores (in standardised tests) higher than their intelligence test scores exceeded the level of performance expected of them, whereas children with attainment test scores lower than their intelligence test scores failed to reach the expected level.

A few investigators have claimed^{2, 3} that by combining Intelligence test-scores with English and Arithmetic scores (standardised tests and school examinations) one could predict later achievement to the extent of a co-efficient of about .8. It is not *possible to raise* the degree of prediction higher since we can hardly hope to prophesy just how the abilities of pupils will develop when they tackle their secondary courses, and it is hardly possible to allow precisely for future health and home-influences². One may do superior or inferior work in higher secondary courses regardless of one's intelligence or background in the junior high school stage.

It has been shown⁴ quite recently that the co-efficient of correlation may go up to .86 or even to .90 if teachers'

¹ N.F.E.R. Allocation studies No. II, 1952-53.

² *J. Educ. Res.*—27, Oct. 1933, pp. 127-30.

³ Vernon P. E.—*Modern Educational Psychology as a Science*, Studies in Education, University of London Institute of Education, 1952, p. 15.

⁴ Vernon P. E. (Ed.)—*Secondary School Selection—A British Psychological Society Enquiry*—Methuen & Co. Ltd—1957, p. 75.

estimate (in regard to the probable success of the pupil in higher education) is included.

Role of other factors :

But why do our predictions, often so elaborately made, fail to reach the perfect standard? Are there any other factors that we should duly consider in this respect? Some psychologists and educators^{1,2,5,6,7} think that our failure is largely due to the neglect of factors like 'persistence', industriousness, 'motivation' (determination), 'personal adjustment', 'interest', 'study-methods' and 'school-attitude'. They claim that these factors contribute much towards one's success in almost all branches of learning.

Some maintain³ that the educational achievement of one's own family should be considered as an important factor for one's further educational progress.

From the follow-back enquiry⁴ conducted by the National Foundation for Educational Research (England and Wales), it has been revealed, through reports submitted by teachers, that a child's success in a secondary school is determined, to some extent, by the degree of security, affection and encouragement, provided by the parents and also by the attitude that the child and its parents have adopted and developed towards its school, its teachers, its class-mates and the type of course followed in the school.

It is clear, therefore, that we have got to take into account a number of personality traits, over and above the two major factors of intelligence and achievement, because these traits have very important bearing on one's

¹ Lindquist E. F.—*Educational Measurement*—American Council of Education, 1950, pp. 92-93.

² Vernon P. E.—*The Structure of Human Abilities*, Methuen & Co. Ltd., 1950, pp. 37-48.

³ Super Donald E.—*Appraising Vocational Fitness*—Harper & Brothers, 1949, p. 90.

⁴ N.F.E.R. in England and Wales, Allocation Studies, II, 1952-53.

⁵ Dale E. R.—*From School to University*, Routledge, Kegan Paul and Co. 1954, pp. 154-61.

⁶ J. Educ. Psychol. 34, 1943, pp. 229-36.

⁷ Educ. Psychol. Meas. V., No. 3, Autumn 1943, pp. 273-83.

ment' to be so. Consequently, it seems to be a very useful and practical suggestion when some educators recommend the combined use of intelligence test-scores, school marks and/or scores on standardised achievement tests for the purpose. In the U.K. (vide Chap VI) there is always the provision for all the three, i.e. the intelligence test scores, scores on standardised achievement tests of English and Arithmetic and school marks in respect of those two major subjects, though the intelligence test-scores are sometimes given greater weight. A few investigations have also been done quite recently by the National Foundation for Educational Research in this respect. It has been claimed¹ that children with attainment test scores (in standardised tests) higher than their intelligence test scores exceeded the level of performance expected of them, whereas children with attainment test scores lower than their intelligence test scores failed to reach the expected level.

A few investigators have claimed^{2,3} that by combining Intelligence test-scores with English and Arithmetic scores (standardised tests and school examinations) one could predict later achievement to the extent of a co-efficient of about .8. It is not *possible to raise* the degree of prediction higher since we can hardly hope to prophesy just how the abilities of pupils will develop when they tackle their secondary courses, and it is hardly possible to allow precisely for future health and home-influences⁴. One may do superior or inferior work in higher secondary courses regardless of one's intelligence or background in the junior high school stage.

It has been shown⁴ quite recently that the co-efficient of correlation may go up to .86 or even to .90 if teachers'

¹ N.F.E.R. Allocation studies No. II, 1952-53.

² *J. Educ. Res.*—27, Oct. 1933, pp. 127-60.

³ Vernon P. E.—*Modern Educational Psychology as a Science, Studies in Education*, University of London Institute of Education, 1952, p. 15.

⁴ Vernon P. E. (Ed.)—*Secondary School Selection—A British Psychological Society Enquiry*—Methuen & Co. Ltd—1957, p. 75.

estimate (in regard to the probable success of the pupil in higher education) is included.

Role of other factors :

But why do our predictions, often so elaborately made, fail to reach the perfect standard? Are there any other factors that we should duly consider in this respect? Some psychologists and educators^{1,2,5,6,7} think that our failure is largely due to the neglect of factors like 'persistence', 'industriousness', 'motivation' (determination), 'personal adjustment', 'interest', 'study-methods' and 'school-attitude'. They claim that these factors contribute much towards one's success in almost all branches of learning.

Some maintain³ that the educational achievement of one's own family should be considered as an important factor for one's further educational progress.

From the follow-back enquiry⁴ conducted by the National Foundation for Educational Research (England and Wales), it has been revealed, through reports submitted by teachers, that a child's success in a secondary school is determined, to some extent, by the degree of security, affection and encouragement, provided by the parents and also by the attitude that the child and its parents have adopted and developed towards its school, its teachers, its class-mates and the type of course followed in the school.

It is clear, therefore, that we have got to take into account a number of personality traits, over and above the two major factors of intelligence and achievement, because these traits have very important bearing on one's

¹ Lindquist E. F.—*Educational Measurement*—American Council of Education, 1950, pp. 92-93.

² Vernon P. E.—*The Structure of Human Abilities*, Methuen & Co. Ltd., 1950, pp. 37-48.

³ Super Donald E.—*Appraising Vocational Fitness*—Harper & Brothers, 1949, p. 90.

⁴ N.F.E.R. in England and Wales, Allocation Studies, II, 1952-53.

⁵ Dale E. R.—*From School to University*, Routledge, Kegan Paul and Co. 1954, pp. 154-61.

⁶ *J. Educ. Psychol.* 34, 1943, pp. 229-36.

⁷ *Educ. Psychol. Meas.* V., No. 3, Autumn 1943, pp. 273-83.

successful achievement in higher education. It is, however, regretted that satisfactory measurement of these personality traits has not gone far enough to justify their inclusion in the test-programme proper, at least at the present stage. The criticism is heard that the vast literature on personality testing has perhaps little of value for predicting higher school achievement.¹ It may be due to the fact that most of the personality tests are found to be lacking in reliability and validity. A few such tests as have proved themselves to be fairly reliable and valid are being primarily used for diagnostic rather than prognostic purposes. We may, however, expect to have some of these included in our future programme. For the present, we may profitably rely on the teacher's rating about these important traits which must find their proper place in the pupils' school record card (to be discussed afterwards). It goes without saying that teachers who would do these ratings should be properly trained, because much depends on these ratings being made as objective, reliable and valid as possible.

Test Programme for General Education :

Thus, we may provisionally decide to frame up in the following way the first section of our programme, which is principally directed towards the discrimination of children who would utilise well the opportunities of higher secondary education when extended to them from those who may not quite do so.

The proposed programme—first section

- (a) Test of general intelligence or general mental ability, or general classification test, as some would like to call it.

We may substitute the terms 'intelligence tests' by 'general educability tests' as recommended by the British Psychological Society.²

¹ Monroe W.—*Encyclopaedia of Educational Research*—Revised Edition, 1950, Macmillan & Co. p. 881.

² Vernon, P. E. (Ed.)—*Secondary School Selection*—A British Psychological Society Enquiry, 1957—Methuen & Co. Ltd. p. 173.

- (b) Standardised tests of attainment in the two major school-subjects of mother language and arithmetic.
- (c) Teachers' ratings in regard to traits like persistence, industriousness, health, motivation, school-attitude, etc.
- (d) Teachers' estimate (over-all) in regard to general suitability for higher education.

B. PREDICTION OF SUCCESS IN THE ELECTIVES

We are now left to consider the different elective groups of the diversified curricula. As in the case of *general* education (core-curriculum), we are again to determine the traits, factors or abilities that distinctively enter into, or contribute significantly towards, one's successful achievement in each of the course-groups. This will help us plan the second section of our programme.

The pre-1940 importance of intelligence test, as a tool for this type of educational guidance, has, as indicated earlier, been seriously challenged. Psychologists of the present age would prefer concentrating their attention on measuring separate intellectual factors instead of only one 'general' factor.¹

We feel that the effectiveness of intelligence tests may be improved if they are made a little broader or wider in respect of the medium of their content. For example, numerical, spatial and other types of items should be used more freely along with the verbal ones, so that part-scores like verbal, numerical, spatial, etc. can be utilised when required.

Most of the American psychologists, however, advocate preparation of aptitude tests for predicting success in a particular subject or a specific area of study, on the analogy that school-marks or teachers' estimates in a particular subject are found to be more effective from the standpoint of predictive validity. Reading prognosis test, algebra prognosis test, etc. are illustrations on the point.

¹ Kornhauser A.—*Replies of psychologists to a short questionnaire on mental test development.* Educ. Psychol. Meas. V. No. 1, pp. 3-6.

Our problem, however, is a bit more complicated. We have got a long list of more than forty subjects classified into seven different streams (vide pp. 8-9 ante) and a student going on to any stream is required to study not more than three subjects of that stream. To be particularly thorough, we would get ourselves involved in the herculean task of developing a huge battery of as many 'prognosis' tests as there are subjects. Nobody, perhaps, would ever think of such a proposition as advisable or practicable. We have got to simplify our work, though certainly not to oversimplify.

There is yet another disturbing feature, the overlapping of certain subjects between the diversified streams. Mathematics goes to three streams,—humanities, science and technical ; geography to humanities, science and commerce ; elementary home science to humanities, science and fine arts ; civics and economics to humanities and commerce ; chemistry and biology of the science stream partially enter into the agriculture stream, and so on. There is even the queer possibility of one particular combination, mathematics, geography and elementary home science, (not an unnatural one, we should say) belonging, as a group, to both the humanities and the science streams. Sometimes, it becomes difficult to guess at the 'rationale' behind such peculiar 'provisions' of subjects in the so-called diversified curricula of our multilateral education. We may feel that we have got to forego our 'scientific straight-forwardness' to solve the problem of '*differential prediction*'. But time and experience will surely help us bring about a system that will be both scientific and comprehensive.

For the present, we should lay sufficient emphasis on only those traits, abilities, or factors which are usually known to be of greater value and significance than others, so far as a pupil's normal achievement in a particular course is concerned. In some courses, however, there are a few compulsory subjects which would definitely help us in the matter of spotting out the specific factors or abilities involved therein.

The Humanities :

The subjects included in the humanities group (p. 8) are more or less similar to those that we usually find in a curriculum for liberal or academic education. Languages (classical and foreign), history and elements of psychology and logic have been exclusively prescribed.

Many educators claim that pupils going on to secondary education of the academic type should possess a high degree of general mental ability including the faculty of reasoning and verbal aptitude¹. Sometimes the global measure of general intelligence is considered sufficiently prognostic of success in the humanities group,⁶ and sometimes tests of logical reasoning, verbal comprehension and word fluency are mentioned separately^{2, 3, 4}. It has also been shown that general intelligence and linguistic ability are highly correlated with one another.⁵

Some investigators, again, have resorted to the recent method of factor-analysis to discover the factors ('unitary' abilities) that enter into pupil-achievement with respect to the specific subjects of the humanities-group (e.g. mother-tongue, foreign language and history). In most of these studies^{7, 8, 9, 10, 11} the general intelligence or 'g' has come out to be the first factor and the verbal ability or 'v' as

¹ *The Norwood Report on Curriculum and Examinations in Secondary Schools*, H.M.S.O., London, 1943.

² Crawford and Burnham—*Forecasting college Achievement*, Yale University Press, 1946, pp. 136-38.

³ Vernon P. E.—*The Structure of Human Abilities*, Methuen & Co. Ltd., 1950, p. 47.

⁴ Ahmavaara Y.—*Transformation Analysis of Factorial Data*, University of Helsinki, 1954, pp. 107-08.

⁵ Graham, P. M. M.—M.A. Thesis, Univ. of London, 1942.

⁶ Herman V. A. C. and others—*Prognosis Tests in Modern foreign-language* McMillan & Co., New York, 1929, pp. 29-31.

⁷ Smith C. H. J.—Ph.D. Thesis, Univ. of London, 1951.

⁸ Rogers C. A.—Ph.D. Thesis, Univ. of London, 1952.

⁹ Peters H. C.—*Prediction of success and failure in Elementary foreign Language*, J. Appld. Psychol. 37, No. 3, June 1953, pp. 178-81.

¹⁰ Maw G. F.—M.A. Thesis, Univ. of London, 1937.

¹¹ Abouzed Hekmat—Ph.D. Thesis, Univ. of London, 1955.

the second. The first factor 'g' and the second factor 'v', have however been differently interpreted by different investigators; for example, 'g' has been named as general intelligence, general intellective factor, general mental ability, logical reasoning or even meaningful memorisation (general) and 'v' has been named as verbal ability, verbal comprehension, vocabulary, verbal meaning or even verbal fluency.

What do all these findings indicate, when placed alongside the first section of our test-programme proposed earlier for predicting success in general education? We have provisionally decided there to include a test of general intelligence and a standardised test of language (mother-tongue) along with a few others. Should we, therefore, propose to have new tests of verbal intelligence, logical reasoning, verbal comprehension and word fluency, for the purpose of predicting one's success in subjects of the humanities course? Or, should we rather reconsider the results of the aforesaid tests of intelligence and language, to determine the individual's potentiality for the humanities group? Perhaps it would be better for us to follow the latter course.

Since most of the tests of 'general intelligence' furnish measures of verbal ability also¹ it seems quite unlikely that the inclusion of any other test would contribute much towards increasing the predictive efficiency of the programme, as a whole. We may, however, do one thing on the analogy of '*verbal quotient*'. The total score of an individual on the verbal section only of the intelligence test proper may be used as an additional index of his verbal ability; and we may wait to see how this procedure actually works in practice and how far we are justified to follow it from the practical standpoint.

We may also say, in support of our suggestion for '*non-inclusion*' of any more test here, that a student selecting the humanities group is practically free to elect any three subjects of the given list (page 8) and the list does

¹ Anastasi A.—*Psychological Testing*—The MacMillan Co. 1954, pp. 12-13.

not appear to be so homogeneous in nature. It would thus appear that addition of any new test would merely make our work-programme unnecessarily heavy.

The following scores may, therefore, be considered separately for estimating an individual's potential success in the 'humanities' course :

- (1) Scores on the general intelligence test.
- (2) Scores on only the verbal part of the general intelligence test.
- (3) Scores on the standardised test of mother-language.

The Science Course :

Our 'science' course includes, along with others, the following four subjects which are more or less specific to this stream :—(a) Physics (b) Elements of Physiology and Hygiene (c) Chemistry and (d) Biology.

A few distinguished experimenters in the field of educational guidance like Crawford and Burnham,¹ Vernon,² Ahmavaara³, etc. suggested that abilities of the following type should be considered for successful prediction in the science course :—

- (a) Quantitative Reasoning.
- (b) Mathematical Aptitude,
- (c) Verbal Reasoning.

These claims are also corroborated by other analytical studies^{4, 5, 6, 7, 8} relating to *factors* or *traits* involved in the learning of subjects specific to this stream. The

¹ Crawford and Burnham—*Forecasting College Achievements*, Yale University Press, 1946, pp. 136-38.

² Vernon P. E.—*The Structure of Human Abilities*, Methuen & Co. Ltd., 1950, p. 47.

³ Ahmavaara Y.—*Transformation Analysis of Factorial Data*, University of Helsinki, 1954, pp. 107-08.

⁴ Berridge A. R.—M.A. Thesis, University of London, 1947.

⁵ Jog R. N.—M.A. Thesis, University of London, 1955.

⁶ Chary K. V.—M.A. Thesis, University of London, 1948.

⁷ Pawley G. C.—M.A. Thesis, University of London, 1937.

⁸ James E.—M.A. Thesis, University of London, 1950.

majority of such studies report the following factors in order of their importance.

- (a) *g* or general intelligence or logical reasoning,
- (b) Verbal factor,
- (c) Arithmetic-Mathematics factor and
- (d) Spatial factor (visual imagery).

But what about mathematics? Should we or should we not specifically consider this subject for our science course? Though mathematics finds its place in more than one course-group, we feel that it should be treated as '*basic*' to the science course.

From an analysis of the findings of a few investigators^{1, 2, 3, 4} we learn that the following factors contribute very highly to mathematical attainments.

- (a) General intellective factor (involving deductive and inductive processes of reasoning).
- (b) Numerical factor.
- (c) Operations in imagery (spatial factor).
- (d) Verbal factor.

The position, therefore, seems to be that for successful achievement in the science course, one may depend, to a great extent, on 'general intelligence' which invariably comes out as the first factor in most of the analytical studies.

It has been claimed,⁵ however, that *non-verbal* '*g*' tests seem to be superior to '*verbal*' ones for predicting mathematical and scientific achievement.

What, then, should we recommend here,—a general intelligence test of the 'non-verbal' type or an ordinary '*g*' test plus some other tests of 'non-verbal' nature? If we decide to have a measure of general intelligence for this course-group we may not insist on having a separate measure of verbal factor though it has been reported to be important for this group. Besides, we have provi-

¹ Mitchell F. W.—Ph.D. Thesis, University of London, 1937.

² Blackwell A. M.—M.A. Thesis, University of London, 1938.

³ Bennett W.—M.A. Thesis, University of London, 1948.

⁴ Jayasuriya J. E.—M.A. Thesis, University of London, 1949.

⁵ Vernon P. E. and Parry J. B.—*Personnel Selection in the British Forces*—Univ. of London, Press, Ltd. 1949, p. 206.

sionally decided to include the verbal factor in our programme for the humanities group.

We should note, however, that the arithmetic-mathematics factor or the numerical factor has got some positive contribution towards successful achievement in the science group, especially in subjects like mathematics, physics and chemistry. It would, therefore, be better for us to have the general intelligence test score supplemented by the 'part-score' on only the numerical section of the same test as well as by the score on the standardised test of arithmetic. This arrangement will not get us involved in any extra load of additional test-administration; but all the same, it will duly emphasize the non-verbal (numerical-arithmetical) aspect of our requirement.

A few educators often talk of Zyve's Scientific Aptitude test¹ as a good predictor of achievement in the science course. Zyve's test purports to measure a conglomeration of eleven traits (e.g. experimental bent, clarity of definitions, suspended versus snap judgement, reasoning, power to detect inconsistencies, power to detect fallacies, induction, deduction and generalisation, caution and thoroughness, discrimination of values in selecting and arranging experimental data, accuracy of interpretation, accuracy of observation) some of which have been separately reported² to be quite suitable for predicting success in the science course.

Perhaps a scientific ability test, on the lines of Zyve, is worth a trial and we may decide to develop a test of scientific ability. The full programme for the science course would, thus, be :

- Scores on the general intelligence test.
- Scores on only the numerical part of the general intelligence test.
- Scores on the standardised test of arithmetic.
- Scores on a scientific ability test.

¹ Buros O. K. (Ed.)—*The Fourth Mental Measurement Year Book*, The Gryphon Press, New Jersey, 1953, p. 810.

² Khan M. A.—M.A. Thesis, University of London, 1951.

*The Technical Course :**

The problem of selecting students for technical education has troubled the minds of educators and psychologists, ever since the establishment of technical high schools on a wider scale.

We begin our discussion here with the developments in this direction in the United Kingdom, then refer to corresponding developments in the U.S.A. and lastly, try to summarise the different findings with a view to suggesting a possible line of approach for our use.

It was stated in the Norwood Report of 1943¹ that technical school pupils should possess the following three traits,—practical ability, an insight into mechanism and a capacity to control material things. Peel has an interesting sentence about technical abilities :

"Here is something not academic, not exclusively verbal and linguistic, but none the less powerful and effective, showing all the essential qualities of intuition, reasoning, analysis and synthesis, in terms of the medium of space-relations, geometrical shapes and solid materials."²

The idea of technical ability as something practical, material (concrete), spatial or mechanical, led to the use of a number of tests for selecting students for technical education. Various experiments were undertaken with test-programmes covering either Alexander's³ 'F' factor (practical ability or concrete intelligence), or El Koussy's⁴ 'k' factor (space-perception, spatio-visual memory or imagery), or Cox's⁵ 'm' factor (mechanical aptitude). It

* This section was published in the form of an article in the *Journal of Vocational and Educational Guidance* (India)—Vol. 6, No. 4, Feb. 1960.

¹ The Norwood Report—*Curriculum and Examination in Secondary Schools*—H.M.S.O., London, 1943.

² Peel F. A.—*Selection for Technical Education*—Educ. Review (Birmingham) 4, No. 3, June, 1952, p. 183.

³ Alexander W. P.—*Intelligence, Concrete and Abstract*—Brit. J. Psychol. Monograph Supplement, XIX, 1935.

⁴ El Koussy A. A. H.—*The visual perception of space*—Brit. J. Psychol. Monograph Supplement, XX, 1935.

⁵ Cox J. W.—*Mechanical Aptitude—Its existence, nature and measurement*—Methuen & Co. Ltd. 1928.

was claimed that the results of specially chosen 'aptitude' tests were a better guide to success in technical subjects in junior school courses and in subsequent engineering work than the results of examinations of an academic nature.¹ But the exact nature of the so-called 'aptitude for technical education' could not be readily analysed and there was deep controversy among the experimenters about the contribution of the special abilities, like practical factor or F, spatial factor or k and mechanical factor or m.

Some^{2, 3, 4, 5, 6, 8} contended that the spatial judgment tests (k factor) were sufficient to discriminate pupils for technical education. Others^{9, 10, 11} claimed that performance tests (practical ability or F factor) consistently yielded useful results for such differentiation. Some others, again, favoured the use of mechanical aptitude tests (Cox's 'm' factor) in the matter of selection for technical education.

One investigator⁷ suggested that all the three factors, 'F', 'k' and 'm' seemed to enter into the mental processes necessary for success in the technical sphere.

It was even claimed^{12, 13, 14} that the spatial judgment tests (k factor) and the performance tests (F factor) would seem to measure the same type of ability.

A few more studies were recently undertaken to show the effectiveness of different types of tests ordinarily used for selection purposes in technical education.

¹ *Occup. Psychol.* XVII, No. 2, April, 1943, pp. 53-63.

² *Occup. Psychol.* XIV, 1940, pp. 39-53.

³ *Occup. Psychol.* XXII, 1948, pp. 213-16.

⁴ *Occup. Psychol.* XIV, 1940, p. 69 and XV, 1941, p. 173.

⁵ *Occup. Psychol.* XVI, 1942, p. 175.

⁶ *Occup. Psychol.* XXII, No. 3, July, 1948, pp. 150-59.

⁷ *Occup. Psychol.* XXI, 1947, pp. 34-48.

⁸ *Brit. J. Psychol. (Statistical Section)*, II, 1949, pp. 3-16.

⁹ *Brit. J. Educ. Psychol.* XVI, 1946, pp. 20-31 and pp. 69-81.

¹⁰ *Brit. J. Educ. Psychol.* XVIII, 1948, pp. 67-86.

¹¹ *Brit. J. Educ. Psychol.* XIX, 1949, pp. 1-15.

¹² *Brit. J. Educ. Psychol.* XVIII, 1948, pp. 121-33.

¹³ Barbara Leff—M.A. Thesis, University of London, 1949.

¹⁴ *Brit. J. Psychol.* XXX, April, 1940, pp. 341-51.

Howard showed that a battery of tests of the following type could satisfactorily predict success in engineering drawing¹ :

spatial visualisation,
performance
space perception
general intelligence (non-verbal)
mechanical explanation

Beverstock² found that a test of general cognitive ability together with one of spatial-mechanical ability could be profitably used for selection of engineering apprentices.

Knight³ supported the selection procedure followed at the Middlesex Junior Technical School Entrance Examination and that selection programme consisted of tests of space-perception, form-relation (space-visualisation), memory for designs and tracing.

Williams⁴, however, claimed that the influences of spatial judgment and mechanical comprehension tests were relatively small as compared with that of the general intelligence factor.

Mitra's⁵ 'follow-up' study showed that the non-verbal tests involving pattern judgment had given the highest co-efficient of correlation with special subjects (other than the 'core' ones) in the technical course. Vernon who suggested⁶ a $k : m$ (spatial-mechanical) complex has lately remarked that apart from the dexterity element and the greater attractiveness of performance tests (F factor) to testees, there was no reason why psychologists should not substitute the more reliable and convenient paper-pencil spatio-mechanical tests ($k : m$ type) for performance tests.⁷

¹ Howard B. S.—M.A. Thesis, London University, 1945.

² Beverstock A. J.—M. A. Thesis, London University, 1946.

³ Knight W. H. H.—M.A. Thesis, London University, 1949.

⁴ William H. S.—Ph.D. Thesis, London University, 1948.

⁵ Mitra J. P.—M.A. Thesis, London University, 1954.

⁶ *Occup. Psychol.*—XXIII, 1949—p. 94.

⁷ Vernon P.E.—*The structure of Human Abilities*, Methuen and Co., London, 1950, p. 112.

Development in the U.S.A. :

Most of the American psychologists¹, however, thought in terms of 'mechanical aptitude' tests ('m' factor) on the assumption that pupils for technical education should possess a capacity to tackle and solve mechanical problems. Three different types of 'mechanical ability' test were developed there, (1) mechanical comprehension or mechanical reasoning (2) mechanical information and (3) mechanical assembly.* Some² suggested that a mechanical assembly test together with a mechanical information test would satisfactorily serve the purpose of selection for technical education; others³ claimed that mechanical knowledge (mechanical information) was an extremely important component of mechanical aptitude.

Some^{4, 5} demonstrated the importance of spatial factor (space-visualisation) with other factors like repetitive movement and perceptual speed, while others⁶ found that the two factors of mechanical experience and visualisation were the most important. Tests of mechanical comprehension, however, were reported to be the most valid for mechanical work in general.⁷

It was even⁸ thought that the aptitude tests were

¹ Paterson D. G. et. al.—*The Minnesota Mechanical Abilities Test*—Minneapolis, University of Minnesota Press, 1930.

* The Minnesota Mechanical Assembly Test, the Minnesota Paper Form-Board, Bennett's Mechanical Comprehension Test, the California Prognostic Test of Mechanical Ability, O'Rourke Mechanical Aptitude Test, etc. are illustrations on the point.

² Bingham W. V.—*Aptitudes and Aptitude Testing*—Harper and Brothers, 1937, Chap. XI.

³ *J. Appld. Psychol.*—36, 1, Feb. 1952—pp. 15-19.

⁴ Harrell T. W.—*A Factor analysis of mechanical abilities test Psychometrika*—5, 1940, pp. 17-33.

⁵ Wittenborn J.R.—*Mechanical ability, its nature and measurement*—*Educ. Psychol. Meas.* 5, 1945, pp. 241-60, and pp. 395-409.

⁶ *J. Appld. Psychol.*—36-6, December, 1952—pp. 381-84.

⁷ Ghiselli E. E.—*The Measurement of Occupational Aptitude*—University of California Publications in Psychology—8-2—University of California Press, 1955, p. 130.

⁸ *J. Appld. Psychol.*—38-6, December, 1954, pp. 381-83.

valuable not merely in predicting successful training but also relative performance after experience on the job.

Such are the claims that have been made by different psychologists, investigators and experimenters in regard to the contribution of factors like F , k and m or of a combination of tests embodying collectively or singly the above factors, or, of practical tests (of the type of *Mechanical Assembling*), for success in technical education.

Let us try to evaluate these claims with a view to arriving at a provisional test programme for the technical stream in our country.

The nature of subjects in the technical stream (p. 8) obviously suggests that we should have a test of general mental ability. Can we propose to use the part-score on the diagrammatic section of our general intelligence test *separately* for this stream to show our concern for the spatial factor? We have proposed to build up our 'general ability' test in such a way that part-scores on verbal and numerical sections of the test can be used to indicate one's verbal and numerical ability respectively whereas the total score i.e. the aggregate score of the verbal, numerical and abstract (diagrammatic) section of the test indicates one's general mental ability. It may not, therefore, be unreasonable to propose using the part-score on the diagrammatic section to indicate one's spatial ability, provided adequate arrangement is made to incorporate sufficient number of items relating to geometrical figures, pattern judgment, etc., into that part of the general intelligence test.

Since, however, spatial ability and mechanical ability have been shown to be of so much value to the technical course, it would be better for us to have two separate tests, one of spatial ability and another of mechanical ability.

We need not include, at present, any performance test or mechanical assembling test for individual administration. As we are interested in organising primarily a mass guidance programme, individual tests* may not prove

* Group administration of these tests, though possible, involves administrative and economic difficulties.

to be so convenient and economical.

Thus, we may provisionally decide to have the following scores to help us in allocating students to the technical course.

- (a) Scores on the general intelligence test.
- (b) Scores on only the diagrammatic part of the general intelligence test.
- (c) Scores on the spatial ability test ('k' factor).
- (d) Scores on the mechanical ability test ('m' factor).

The Fine Arts :

Before we take up the issue of predicting success in the fine arts course, we should make a careful study of the related research-work to identify the fundamental 'factors' that underlie 'art-ability'. We usually have two broad categories of art-education, (a) Fine arts including drawing, painting, modelling and sculpture and (b) Music and dancing.

Artistic ability :

The principal constituents of *art-ability* as involved in subjects of the first category are :

- (a) *Aesthetic-appreciation*:^{1, 2, 3, 4}
- (b) *Ability to reconstruct design*:⁵
- (c) *Sensitivity to colour harmony*:⁶
- (d) *Apperception (i.e. completion of an object from visual images of the whole)*:⁷
- (e) *Intelligence as measured by intelligence tests*:⁸
- (f) *Creative imagination*:⁹

¹ Berliner Anna—*Aesthetic Judgement of school children*—J. Appld. Psychol.—2, (1918)—pp. 229-42.

² Karwoski T. F. & Christensen E. O.—*A test for art appreciation*, J. Educ. Psychol.—XVII, 1926, pp. 187-94.

³ Bulley M. A.—*Have you good taste?*—Methuen & Co., Ltd., 1933, pp. 44-52.

⁴ Occup. Psychol.—XVI—(1942)—pp. 183-89.

⁵ Psychol. Monograph—45-1—(1933), pp. 1-11.

⁶ —do— pp. 51-62.

⁷ —do— pp. 108-33.

⁸ —do— 48-1—(1936), pp. 95-125.

⁹ —do— 51-5—(1939), pp. 88-102.

Meier and his students following a method of analysis which was partly biographical and partly mensural (not factor analysis), broke up artistic ability into the following six components¹ :—

- (a) Manual skill.
- (b) Energy output and perseveration in its discharge.
- (c) Spatial and perceptual aptitude (aesthetic intelligence).
- (d) Perceptual facility (recalling sensory experiences)
- (e) Creative imagination (organising sense-impressions into aesthetic products).
- (f) Aesthetic judgment (recognising unity of composition).

Meier, however, considered the factor of 'aesthetic judgment' (no. f.) to be the most important single factor and so he developed his 'Art Judgment' test which subsequently proved to be of considerable value for selecting students for the art courses². Graves 'Design Judgment' test³ also emphasized the 'judgment' aspect of art-ability.

Thus we find that, of all the constituents of art-ability (of the first category), psychometricians have mostly relied on '*aesthetic appreciation and judgment*' and their reliance has not so far been seriously challenged. But we ignore, perhaps, one very important aspect of art-ability, i.e. the creative aspect. Recently a few tests of creative artistic ability have been developed to measure one's ability to construct a good artistic design or to utilise the concepts, vocabulary and tools of the artist. The Lewerenz tests in the fundamental abilities of visual art and the Knauber art ability test are instances on the point⁴. These two tests are claimed to be most effective for differentiation

¹ *Psychol. Monograph*—51—5—(1939) pp. 140-58.

² Super Donald E—*Appraising Vocational Fitness* Harper and Brothers, 1949, p. 313.

³ Buros O. K. (Ed.)—*The 4th Mental Measurement Year Book*—The Gryphon Press, (1953) pp. 335-37.

⁴ Monroe—*Encyclopaedia of Educational Research*, Revised Edition, (1950), Macmillan & Co., p. 69.

purpose at the high school level. It has also been suggested that tests on 'visuo-kinaesthetic imagery' may satisfactorily predict success in art-education¹.

Musical ability:

Most of the earlier tests of musical ability were more acoustical than musical in character, measuring as they did the related sensory-motor capacities as against the dynamic patterns of tones characterising musical perception. Of course, the importance of the psycho-physical capacities has been demonstrably confirmed. Modern psychometrists², however, feel interested in developing tests of more complex musical functions and it is expected that accumulated evidences along this line will contribute much towards the development of new 'tools' with higher validity.

From Monroe's synoptic account³ of the related literature and tests, one may conclude that the following four factors are more significant than others in musical ability.

- (a) Musical memory, (b) Auditory sensitivity (musical sensitivity) (c) Musical feeling and understanding
- (d) Sense of rhythm.

'Seashore Measures of Musical Talents' and the 'Kwalwasser Dykama Music Test' are illustrations on the point.⁴

* * * * *

Let us, now, suggest a test programme for our 'fine arts' course. It has been made clear that we should have two sets of test-batteries to embody the two broad categories of artistic ability, namely, fine arts and music.

In our syllabus for the fine arts stream, we have got one compulsory subject,—appreciation of art including history of art and the following elective subjects (any two): (i) drawing and painting, (ii) modelling and sculpture, (iii) music and (iv) dancing. It is presumed that pupils would normally

¹ Barney W. D.—Ph.D. Thesis, London University, 1952.

² Wing H. D.—M.A. Thesis, London University, 1937.

³ Monroe W.—*Encyclopaedia of Educational Research*, Revised Edition, (1950), MacMillan & Co. pp. 762-63.

⁴ Buros O. K. (Ed.)—*The 3rd Mental Measurement Year Book*—Rutgers University Press, New Brunswick, 1949 pp. 260-64.

elect either (i) and (ii) or (iii) and (iv), as that will be quite in keeping with the above two categories of art-education. Of course a clear-cut directive on the point would be of great relief. A test of *aesthetic appreciation and judgement* together with a sub-test of creative art-ability will cover art-ability of the first category i.e. art-ability as involved in drawing & painting or modelling & sculpture.

Another test of musical ability along modern lines will meet the demand of art ability of the second category, as involved in music and dancing.

We need not consider the general intelligence test score separately for this course, as none of the investigators have greatly emphasized its importance for art-education.

The Commerce Course:

On an analysis of the work normally associated with different aspects of commercial education e.g. typewriting and shorthand, correspondence, filing, checking and drafting, business arithmetic, book-keeping, accounting, etc., one may arrive at the following basic requirements for success in the field :—

- (i) Speed and accuracy in checking numerical and verbal symbols.
- (ii) Speed and accuracy in copying words and numbers.
- (iii) Finger-dexterity (involved in rapid manipulation of papers, cards, pencils, etc.).
- (iv) Proficiency in simple arithmetical calculations including business arithmetic.
- (v) Proficiency in language (spelling, composition, etc.).

[Of course, higher levels of commercial work that involve planning and decision-making demand reasoning and abstract thinking.]

Some would emphasize the first two requirements only^{1, 2} and build up tests of 'perceptual speed and

¹ *The 4th Mental Measurement Year Book*, (O. K. Buros, Ed.)

The Gryphon Press, New Jersey, 1953, p. 711.

² *The 3rd Mental Measurement Year Book*, (O. K. Buros, Ed.)

Rutgers University Press, New Brunswick, 1949, p. 628.

accuracy' * (e.g. name checking, number checking, classification of number and/or names, etc.). The Minnesota Clerical Test which is sufficiently widely used^{1,2,3} for the purpose is an illustration on the point.

Others emphasize almost all the basic requirements more or less equally and build up tests containing items that can be grouped as follows :—

*checking,
classification,
filing,
arithmetic computation,
arithmetic reasoning,
copying,
sorting,
spelling,
grammar,
composition,*

The Psychological Corporation General Clerical Test and the N.I.I.P. Group Test 25 can be cited as illustrative examples.^{4,5,6}

A few investigators were interested in making a comparative study of the usefulness of different clerical aptitude tests in order to decide on the shortest but the most

* It may be noted that 'perceptual speed and accuracy' involved in commercial work should be distinguished from 'perceptual speed and accuracy' in 'space-relation' problems, connected with technical education.

¹ Super Donald E.—*Appraising Vocational Fitness*—Harper and Bros. 1949, pp. 164-83.

² Hay E. N.—*Predicting success in machine book-keeping*—J. Appld. Psychol.—27—1943, pp. 483-93.

³ Monroe W.—*Encyclopaedia of Educational Research*, Revised Edition, 1950, MacMillan & Co., p. 887.

⁴ *The 4th Mental Measurement Year Book* (O. K. Buros, Ed.)—The Gryphon Press, New Jersey, 1953, p. 712, pp. 720-22.

⁵ The Report of the Jt. Committee of the Association of Tech. Institutions and the Association of the Principals of Tech. Institutions, England, 1945, p. 18.

⁶ Vernon P. E. & Parry J. B.—*Personal Selection in the British Forces* University of London Press, Ltd. 1949, pp. 222-24.

effective form of such tests. The following subtests were reported to be the most important^{1,2,3}

- (i) perceptual speed,
- (ii) arithmetic,
- (iii) name-comparison.

From a number of studies on factorial analysis of skill in commercial subjects^{4,5} we come to know that the following factors are highly related to success in commercial education :

- (i) verbal factor,
- (ii) reasoning factor and
- (iii) numerical factor.

From all these studies related to either the experimental use of clerical aptitude tests or factor-analysis of scores on subjects of the commercial course, we may, perhaps, decide to build up a new test of commercial ability with subtests of the following type:

- (a) Perceptual speed and analysis (with names and numbers)
- (b) Arithmetic (computation)
- (c) Verbal comprehension (including spelling, grammar, etc.)

We need not consider the general intelligence test-score separately for this stream. Though higher levels of commercial work are said to be associated with abstract reasoning, majority of commercial activities usually demand only average intelligence. Besides, we have already proposed to use the general intelligence test-scores for the prediction of general suitability for higher secondary education. It is quite likely, therefore, that scores on the proposed 'commercial ability' test alone will serve our purpose here.

¹ *J. Appld. Psychol.* 35, No. 4, Augusa, 1951, pp. 345-49.

² *J. Appld. Psychol.* 38, No. 5, Oct. 1954, pp. 299-301.

³ Ghiselli E. E.—*The Measurement of Occupational Aptitude*
University of California Publications in Psychology, Vol. 8, No. 2, University of California Press, 1955, p. 113.

⁴ Seddon R.—Ph.D. Thesis, London University, 1949.

⁵ Jackson J. G. C.—M.A. Thesis, London University, 1953.

The Agriculture :

It has been mentioned earlier (Chap. V) that this agriculture stream is relatively new in the field of secondary education. No such definitive study specifically related to mental abilities or factors involved in subjects of this stream is readily available. The 'Arm Dexterity' (motor ability) test has been reported¹ to be a valuable aid to prediction of success in agricultural and horticultural occupations. Two other tests,—(a) *animal husbandry test* and (b) *farm shop tool recognition and use test*, developed at the Indiana State High School Testing Service, Purdue University² may also offer some useful suggestions towards the construction of an 'ability' (?) test for agricultural education. A long-term view of the scheme of having an agricultural stream in the reformed system of our multi-lateral secondary education may demand that we should take up a research project for developing an 'aptitude' test for the purpose.

An analysis of the subjects included in the course (pp. 8-9) at the secondary stage as well as of some kindred occupations should precede our test-development project. We may, however, start with an information type of test with items of the following nature to meet our immediate requirement :

- (a) identifying simple agricultural tools.
- (b) recognising the broad functions of some common tools of agriculture.
- (c) recognising the common plants and crops.
- (d) general information about climate, rainfall, cultivation time, soil, etc. and their relation to different crops and plants.

So long this 'test' is not developed and properly validated, we may consider using here the individual's score in the 'scientific ability test' in view of the fact that a few subjects of this course, like agricultural biology

¹ Ghiselli E. E.—*Measurement of Occupational Aptitudes*—University of California Publication in Psychology. Vol. 8 No. 2, University of California Press, 1955, pp. 124-25.

² Buros O. K. (Ed.)—*The 3rd Mental measurement Year Book*—Rutgers University Press, 1949, p. 442.

and agricultural chemistry, have got close affinities with some basic subjects of the science course.

The Home Science:

This course also is relatively recent in the field of secondary education. The question of adapting the home science curriculum for a special group of secondary school pupils has not yet received due consideration in formal research. As such, this area also remains more or less unexplored and no useful data regarding the place of mental factors or abilities, in this type of curriculum, are readily available.

The home science stream is intended mostly for girl students and the subjects included (p. 9) are very largely concerned with different areas of personal and home living. The course involves activities which relate to food, clothing, housing, child care and development, growth and development of other members of the family, development of social relationship and group-interests within the family, use of leisure time and other socio-economic practices connected with home life.

A few tests, developed by some American educators in this regard¹ would show that 'testing' could be usefully related to this stream as well. Perhaps, it is too early to think of a similar project in our country; but we may have to build up a 'test' for the stream in the near future.

For the time being, our decision on this point may be made on the basis of some, say, 'non-psychometric' data collected through a variety of methods and agents, details of which will be discussed in later chapters.

* * * * *

C. ORGANISATION OF THE TEST BATTERY

We now come to the end of our discussion on the

¹ Buros O. K. (Ed.)

(a) *The 3rd Mental Measurement Year Book*. Rutgers Univ. Press. (1949) pp. 476-78.

(b) *The 4th Mental Measurement Year Book*, The Gryphon Press, 1953, pp. 553-57.

'test-programme'. We need many kinds of test to cover the entire field. We also have to deal with the problem of differential prediction which requires a comparative study of the individual's assets and liabilities in different areas, in order to find out the particular area where that individual is expected to do his best. Naturally we have to set up a test programme that will yield differential assessments to facilitate our work.

The test-battery can be organised in any one of the following ways:

(a) It can be planned on the pattern of the 'Yale Battery of Educational Aptitude Test'¹ yielding broad sub-scores like verbal facility, linguistic aptitude, verbal reasoning, quantitative reasoning, mathematical aptitude, spatial visualisation, mechanical ingenuity, etc.

(b) It can be planned according to the suggestions of Earle² who recommended the grouping of different types of items (e.g. vocabulary, sentence completion, number series, form perception, reasoning, etc.) into such homogeneous sub-parts as would yield part scores that might indicate the individual's abilities in different subjects of the curriculum (e.g. ability in language, ability in algebra, geometry or science, etc.).

(c) It can be done after the pattern of the Differential Aptitude Test Battery of the Psychological Corporation, the General Aptitude Test Battery of the United States Employment Service, the Guilford Zimmerman Aptitude Survey or any other multi-factor test.³ All these patterns give sub-scores that can be used as indices of some fairly well-established mental factors, (special abilities, primary abilities or aptitudes, as these are sometimes called), and not of *coarse* groupings of abilities like verbal, quantitative, mathematical, mechanical, etc.

¹ Crawford and Burnham—*Forecasting College Achievements*—Yale University Press, 1946.

² Earle F. M.—*Tests of ability for secondary school course*, Univ. of London Press, Ltd. 1936, pp. 39-63.

³ *Personnel Guid. J.*—A.P.G.A., Washington 5, D.C. Sept. '56—Sept. '57.

(d) It can also be done on the lines of Morrisby's Differential Test Battery¹ which has been developed quite recently. The battery consists of twelve tests involving, in their performance, those aspects of mental ability that seem to be important in the psychological description of the cognitive structure of a person, the underlying hypothesis being that the ability of a person is a complex 'whole' of several dimensions. The battery has also been designed to yield—

- (i) the measure of an overall level of general ability,
- (ii) measures of various factors or special abilities,
- (iii) a descriptive pattern of the persons' abilities, by combining different score-sets (suited to the purpose).

After a critical study of these four ways, one may feel that attempts should be made, in Indian Education, to develop a differential test battery of Morrisby's type, with some such modifications and additions as are essentially demanded by the requirements of our educational system.

* * * * *

Here is the test-programme, as visualised so far, in a synoptic form:

*Outline of the Test Programme
(Ability Section)*

- (a) Two standardised attainment tests,—One in mother tongue and the other in arithmetic.
- (b) One 'general mental ability' test (with three sectional parts) yielding one global score indicative of 'g' as well as three part-scores indicative of verbal, numerical and spatial (diagrammatic) ability.

¹ Morrisby J. R.—*The differential Test Battery*,—N.F.E.R. Bulletin No. 6, Nov., 1955, pp. 27-31 (London).

(c) A differential test-battery consisting of the following tests :

- (i) Scientific ability.
- (ii) Space-relations ability.
- (iii) Mechanical comprehension and information.
- (iv) Art ability.
- (v) Musical ability.
- (vi) Commercial Ability.

[Two other tests are likely to be added to the battery in due course—an aptitude test for agriculture and an aptitude test for home science.]

CHAPTER VIII

Interest and its role

We have suggested in Chap. V that the findings of ability-testing alone are insufficient to justify us in guiding a pupil to a particular stream of the diversified course. In this matter many would like to emphasize the role of interest.

In educational guidance, 'Interest' has probably received more attention during recent times than any other single type of human characteristic. But there is a crucial point to be considered. Do the predominant abilities and the predominant interests of the same individual point the same way? Are 'abilities' and 'interests' of corresponding types highly correlated with one another? Bingham¹ once stated "More often than not, a person can learn to do best what interests him most, and conversely, is likely to develop an interest in doing what he finds that he can do best". Without such an assumption to fall back, we would find ourselves in a confusing situation. If 'abilities' point one way and 'interests' another, it would be difficult for us to come to a final decision, unless we know which of these two should be judged more reliable and powerful.

Some educators firmly believe that genuine cases of deep-seated (not transient or fleeting) interest can largely compensate for lack of ability in the early stages of work or study, by conferring an abundant measure of persistence leading possibly in later life to nothing less than first class ability for creative work or research.²

Perhaps educators who are 'ability-minded' would not entirely agree with this. But the importance of interest

¹ Bingham, W. V. D.—*Aptitude and Aptitude Testing*—Harper and Brothers (1937), p. 61.

² The Report of the Joint Committee of the Association of Technical Institution and the Association of the Principals of Technical Institutions, England.—1945, p. 12.

for differential prediction has been amply demonstrated by a number of researchers in the field.^{1,2,3}

It has been suggested earlier that there are different types of interest that correspond fairly closely to the majority of these diversified courses. It is quite possible that at every level of ability some children can develop strong interest in literature or in science, in technology, art, music or commercial subjects. It is also true that with some children teachers require special alertness and effort to discover and develop their interest in any particular type of school activities.

There are, however, two main difficulties that hinder our use of the interest-factor in the guidance programme.

First of all, there is the vexed problem of distinguishing, in the life of the young adolescent, the more permanent interests from many ephemeral ones, though Lambert⁴ has stated that evidence in connection with stabilisation of pupils' dislike for certain subjects and reasonable consistency of their interest in certain other subjects, between 12 to 14 years, suggests the importance of interest in the choice of subjects at that stage.

Secondly, there is the question of valid and reliable assessment of interest. This issue has been made more complicated by the fact that the term '*interest*' is usually given the following four major interpretations, each of which is associated with a particular method of obtaining data for its assessment :

- (i) Expressed interest (ii) Manifest interest (iii) Inventoried interest and (iv) Tested interest.

(i) *Expressed interest* usually means the verbal profession of interest in an object, activity or occupation. This type of interest is normally assessed by means of the testees' subjective feelings of pleasure or displeasure expressed through their preferences, likes or dislikes. The

¹ Beverstock A. G.—M.A. Thesis, London University, 1946.

² Pasricha B. S.—M. A. Thesis, London University, 1949.

³ Peel E. A.—'Assessment of childrens' interest by vocabulary method'—Educ. Review, Institute of Education, Brimingham Univ.—4, No. 2, Feb, 1952, pp. 164-69.

⁴ Lambert C. M.—M.A. Thesis, London University, 1944.

methods usually followed are rating, ranking, voting, questionnaire or paired comparisons. These expressed interests, however, are usually so unstable, especially among children and adolescents, that they do not provide very useful data for prognosis. Besides, there is the 'danger' of 'faking' in the nature of the methods themselves and the consequent unreliability of the data derived therefrom.¹ Some, however, have shown that interest-measures obtained by this method would correlate fairly satisfactorily with self-estimated interest.²

(ii) *Manifest interest* is usually assessed through the individual's actual participation in an activity or task or even the by-product of an activity. The method followed is that of indirect questionnaire, based on usually the co-curricular or extra-curricular activities in the school or the leisure-time activities or hobbies at home. Children are asked to check, from a given list, only those activities in which they actually participate and, then, from the nature of the activities checked, an inference is made of their dominant interests. Sometimes, teachers or parents are asked to give their estimates in this regard.

(iii) *Inventoried interest* is more or less similar to expressed interest with only this difference that, in inventoried interest, each possible response of preferences, likes or dislikes [e.g. L(like), D(dislike), ? (Not sure); yes, no, ? etc.] is given an experimentally determined weight. The total weight (or aggregate score) thus obtained shows the individual's interest-trend and the dominant interest.

(iv) *Tested Interest* is interest measured by an 'objective' and external method. The idea behind such a method is that children usually know more about and respond to the things that interest them, and that by such responses we can detect their interests. In one such method, "the information type", the child chooses three from six given items, and his three choices indicate his "preference" score. In "the projective type" method the child is asked to give the meanings of a list of words

¹ *J. Appld. Psychol.*, 32, no. 4, Aug. 1948, pp. 360-69.

² *J. Appld. Psychol.*, 34, no. 1, Feb. 1950, pp. 42-49.

drawn from different areas of interest, and from the words correctly answered his "preference score" may be decided. In a variation of this method, the individual may give the meaning of a list of words each of which has more than one meaning; the meanings he selects most readily give the preference score. It is claimed that these 'information' tests and 'projective' tests (and others, known as 'vocabulary profile' tests) yield valid and reliable data for use in educational guidance.^{1,2,3}

Some investigators⁴ put forward a scheme of interest-measurement through the 'needs' of the individual, the assumption being that interests in activities or subjects of study persist only so long as they satisfy some of the basic needs of the individual. It may, however, be noted that interests may change to new activities, subjects or fields even though the 'needs' (the value systems) of the individual remain unchanged. It may also be that an individual would continue to be interested in a particular type of activity or experience, though his needs may have changed appreciably during the period. So it is not quite clear how the measurement of 'needs' would correctly reflect the existing interest-pattern of the individual.

It is often claimed that we should, while assessing interest, bear in mind the distinction between attitude and interest, though the distinction, perhaps, is not very clear. Both the concepts, attitude and interest, involve feelings of liking-disliking, attraction-repulsion or acceptance-rejection. Some say that interests are likings or dislikings for activities whereas attitudes are likings or dislikings for objects, persons or ideas.⁵ On the strength of this assumption, it would be better for us to present items

¹ Peel E. A.—'Assessment of children's interest by vocabulary method' Educ. Review, February '52, pp. 164-69.

² Lambert, C.M.—Ph.D. Thesis, London University, 1952.

³ Super, Donald E.—'Appraising Vocational Fitness' Harper and Brothers (1949) p. 376 f.

⁴ Chaudhury K. P.—M.A. Thesis, London Univ. 1948.

⁵ Travers M. W.—*Educational Measurement*, The Macmillan Company, 1955, p. 288.

of an interest-inventory in such a way that they all look like activities.

We would suggest that a combination of the two methods of assessing interests—information and projective—is expected to give a fairly reliable measure of the dominant interest-pattern of the individual. We may, however, gain supplementary knowledge about the individual's interest-trend in its expressed aspect through a section of the *pupils' questionnaire*, or, in its manifest aspect through items in the *parents' questionnaire* and the *school record card*, which are all discussed in subsequent chapters.

CHAPTER IX

The School Record Card*

The 'Record Card' system is a relatively recent practice in the field of education. This system is primarily designed to provide a comprehensive report of a student's many-sided developments through his school-life. Among the principal objectives of such record cards, the following may be specifically mentioned.

- (a) Identifying a student's strengths and weaknesses, his abilities and defects.
- (b) Helping a student to plan his future career (educational and vocational).
- (c) Identifying a student's problems of adjustment in life.
- (d) Serving as a basis for sending reports about a student to institutions of higher training or to prospective employers.

Perhaps nobody would deny that the record cards would make significant contribution to the welfare of school children. They are expected to be of special value to the guidance workers who have got to advise the pupils at very critical stages of their career.

But the value of these cards necessarily depends on the nature and structure of their contents¹. The cumulative record card should, in the main, be considered as an '*evaluation-tool*' for use in the reorganised structure of secondary education. It is but natural, therefore, that this '*evaluation tool*' should be constructed and developed in accordance with the fundamental objectives of our *education-system*. Normally, the content and structure of the record card would be different for different countries or for different peoples, practising different ideals of life

* Some portion of this chapter has been incorporated in the author's booklet, *The Cumulative Record Card*.

¹ Mahanta D.—*The Cumulative Record Card*, Teachers' Quarterly, IV, no. I and no. II, 1959.

and fostering different concepts of living in and through the society. As such, it becomes imperative on our part to clarify the relation between the aims and objectives of our secondary education on the one hand and the content-structure of the record card on the other. In an education system which is rigidly controlled by a prescribed curriculum, distributed by authorised agencies into a number of 'blocks' to be covered in course of a few successive academic sessions, the teachers or educators probably think of the *principle of selection or rejection* as the guiding policy for determining the content-structure of the card.

If, however, we think in terms of an education system adapted to the concept of '*personality development*' the record card would at once demand a content-structure which must be both diagnostic and prognostic in nature. The different items of such a record card shall have to be so chosen and placed that the card would best serve the purpose of a 'tool' to be used maximally for the betterment of the educands from all possible standpoints. That is, the card so constructed is expected to be of maximum help to the educators for *understanding* the children under their charge, their needs and their subsequent roles in the social or national set-up as well as for *fostering* the educands' personality to its fullest extent. In other words, if we really pledge ourselves to this goal of *personality development*, the *card* should be so designed as to give a systematic account of all the valuable information about children which would aid the educators to understand them fully, to educate them properly, to advise them adequately and to plan suitably the courses and careers that would suit them best in their subsequent roles in society. All these concepts of understanding, educating, advising and planning must of necessity be interpreted relatively in the context of the prevailing social goals i.e. the aims of life and living, accepted and practised by the society. It is needless to suggest that the card should contain information about an individual not merely as an individual but as one belonging to a society. It should contain all significant

items necessary for a comprehensive, though analytic, study of the individual, as placed (or likely to be placed) in the social organisation, with its distinctive features of educational administrations, training facilities, the occupational structure (or the trend of such structure) and the employment potentialities and opportunities.

As we envisage at the present moment, all children of the soil would receive compulsory education upto the age of 14 plus in the same type of school and through a curriculum of more or less similar nature. We go to organise, thereafter, a programme of guidance services for those who would be fortunate, in a sense, to continue their studies in the higher secondary courses. But should we not do anything for the unfortunate *school-leavers* who would, perhaps, constitute the vast majority for some years to come? The Central Advisory Board of Education (Government of India), while supporting the recommendations of the Secondary Education Commission in regard to the provision of diversified courses at the higher secondary stage, considered it equally important that there should be large-scale expansion in the provision of trade schools or schools of industry, for the benefit of those who would be unfit for a full course of higher secondary education or who would leave school for economic reasons and find it necessary to earn a living at an early age. The Board also recommended that special steps should be taken to organise apprenticeship training in the diverse types of trade, in close collaboration with the industrial organisations, as well as to establish technical schools, at the same level as the normal secondary schools, with the object of providing the above apprentices with the required amount of advanced knowledge and training in the respective trades plus some general education, on a part-time basis.¹

We should, therefore, plan our record card in such a way that this vast mass of youthful children who are badly in need of vocational placement might be assisted

¹ Proceedings of the 20th and 21st Meetings of the Central Advisory Board of Education in India, Ministry of Education, Govt. of India (1955)—pp. 307-08.

in some way or other. The objectives of educational guidance and vocational advising, for children of the same age group and with similar educational background, do not lie far apart. In fact, the Government of India have named the guidance bureau at the centre as the 'Bureau of Educational and Vocational Guidance', and not merely educational guidance, and this, perhaps, clearly indicates that we are to see to both the aspects of the problem.

We may usefully consider here the system of school records referred to in the "Edinburgh Experiment".¹ It has been rightly suggested that a thorough understanding of the findings of 'individual analysis', through their relationships with the findings of 'curriculum analysis' on the one hand and 'occupational analysis' on the other, would successfully solve the problem of educational and vocational guidance. In a report on Juvenile (now, Youth) Employment Service, published by the Ministry of Labour and National Service (U.K.) in 1945, it was recommended that teachers should prepare a special report for each child, in general accordance with a schedule based on the 'seven point plant' of the National Institute of Industrial Psychology.^{2, 3, 4}

The plan covers the following areas :

- (a) Physical characteristics or qualities.
- (b) Educational attainments.
- (c) General intelligence or general mental ability.
- (d) Special abilities.
- (e) Interest.
- (f) Dispositions (e.g. impressiveness, leadership, steadiness, dependability, self-reliance, etc.).
- (g) Home circumstances (e.g. home conditions, family occupations or opportunities, socio-economic status, etc.).

¹ *Occup. Psychol.* XII, no. 4, Autumn, 1938, pp. 291-301.

² Rodger Alec—*School Records—A Further Comment on the Ince Report*, *Occup. Psychol.* XXII, 1948, pp. 46-49.

³ Hunt E. P.—*The Birmingham Experiments in Vocational Selection and Guidance*, *Occup. Psychol.* XVII, No. 2, April '43, pp. 43-53.

⁴ Smith Percival—*Twenty Five Years of Research in Vocational Guidance*. *Occup. Psychol.* XXV, 1951, pp. 35-43.

Our Secondary Education Commission presented specimen forms¹ of both the cumulative record card and the school leaving certificate and these forms covered practically all the areas of the 'seven point plan'. The Workshop on Vocational Guidance organised by the Government of India recommended the use of record cards prepared almost along similar lines.²

Any way, we are to remember that the cumulative record card will not only give a clear picture of the child's life at progressive stages of its development, it will also provide the most valuable information for a quick but sure review of the child's position, whenever important decisions are to be made about his future course of action,—educational, vocational or otherwise.

The following headings will serve the purpose of curricular guidance for children going on to higher secondary schools:

- (a) Personal data of a general nature.
- (b) Physical characteristics and qualities.
- (c) Educational attainment (school examination results).
- (d) Results of standardised achievement tests.
- (e) Results of psychological tests (general and special).
- (f) School attendance.
- (g) Interest-trends.
- (h) Dispositional characteristics and personality traits.
- (i) Family background and home circumstances.
- (j) Co-curricular activities.
- (k) Special merits and/or disabilities.
- (l) Teachers' estimates and comments in regard to achievement, ability, interest, personality traits or personality development in general.
- (m) Teachers' suggestions or recommendations in regard to future course of action.

¹ The Report of the Secondary Education Commission, Govt. of India (1952-53), pp. 289-300.

² Report of the Workshop on Vocational Guidance, Ministry of Education, Govt. of India, 1955.

It must, however, be mentioned that though the record cards used in most progressive countries show a fairly uniform agreement with regard to general content, different headings are often given varying degrees of importance and oftentimes these are arranged or presented in a variety of ways. Such diversity is due to differing ideals of education in different countries. It is true that the design of the 'Record Card' should depend primarily on the nature of the broad objectives which the cards intend to cover as well as on the nature of the uses which the card would subsequently be put to. Miss Walker who carried out a comprehensive survey of pupils' record cards, in England and Wales, has reviewed in her report¹ the essential purposes of such record cards classifying alongwith the principles which control and determine the construction and use of different types of record cards in schools. The form or design of the cards will also be strongly influenced by the general attitude of the school-system towards the aims of education; for example, in the *progressive system*, particular attention is paid to the recording of the child's progress in personal and social traits, whereas in the *traditional system* of formal curriculum, the examination-results in different school-subjects are given much prominence over the records of developmental qualities of personality and in the *comprehensive school system*, the record cards include detailed headings wherein notes are made of the emergence in the child's life of the special abilities, the interest-trends and the motivational directions, through the progressive development of its 'self-concept'. Our multilateral schools, perhaps, fall under the category of the comprehensive school system.

Of course, much of the nature of the contents of a school record depends on the following points as well.

- (i) The instruments of evalution readily available for use.

¹ Walker Alice S.—*Pupils' Record Card*—Published for the N.F.E.R. (England and Wales) by Newnes Educational Publishing Co. Ltd., 1955.

(ii) The amount of work which would devolve on the school-personnel.

A well thought-out record card form* of the type suggested here (pp. 96-97) and its regular use in schools would, it is expected, rule out the chances of teachers' observations and readings about the children under their charge being haphazard or merely impressionistic, and consequently, less significant and reliable. It is not implied, however, that the record card should be made rigidly formal or stereotyped. The card is merely a tool at the hands of the guidance-workers and its real value depends on its wise and enlightened use.

One may argue, however, that information on some of the points included in the card should be collected through 'objective' tests rather than through the subjective estimates of teachers. But we should not forget that the entire scheme of educational guidance is only at its starting point. It will have to make an appreciable progress before the highly 'technical' tools are considered for regular use. The techniques and tools that have already been evaluated and appreciated may immediately find their place in the scheme, as far as practicable. Other tools and techniques, considered to be necessary for the purpose, should in the meantime be duly developed. Over and above the question of administrative ease, economy and feasibility at the present moment, there is Hamley's warning.¹ "Any sudden change in the direction of more scientific methods is likely to bring about a wrong attitude on the part of the teacher and to dehumanise his contact with the child". Modern techniques of education are perhaps antithetical to rigid formulae and they rely essentially on "intuitive judgement in the teacher and make as great a call upon his art as upon his science."

* For a detailed discussion on the form, the author's articles on 'The Cumulative Record Card' may be consulted, vide 'Teachers' Quarterly' (India)—Vol. IV, No. I-IV, (1959), Calcutta.

¹ Hamley H. R. et al—*The Educational Guidance of the school child*, Evan Brothers, Ltd. London, pp. 13-14.

An outline of the School Record Card

1. Personal date (of strictly factual nature) e.g. name, admission number, date of birth, name of the father or guardian, address, etc.
2. Qualities and condition of health (preferably school medical officer's report), especially, capacity for physical work, physical disabilities, if any.
- *3. Estimates of intellectual qualities—general mental ability and special abilities related to literary or linguistic, mathematical, scientific, mechanical, artistic or musical type of work.
- *4. Estimates of temperament and personality traits—especially, persistence, industry, initiative, motivation, etc.
- *5. Estimates of personal habits—especially, method of study, method of work, co-operativeness, etc.
- *6. Estimates of attitudes—especially, attitude towards school, towards teachers and towards courses of higher study.
- *7. Estimates of interest-trends related to fields of literature, science, technology, mathematics, fine arts, music, business, social service, religion, agriculture, family welfare, etc.
8. Outstanding feature, if any.
9. Attainments :
 - (a) Curricular Section—
 - (i) Examination marks in different subjects or major subject-parts including practical work (results of ordinary as well as standardised tests).

* Recording of estimate on these items may be made on a five-point scale, e.g.,

Estimate of general mental ability	Very high	high	average	low	very low
or, estimate of persistence	high	moderate	so so	low	very low
or, estimate of interest	highly interested	moderately interested	so so interested	not so interested	not at all interested

(ii) Teachers' estimates in regard to general standard of school work, subjects liked most or subjects liked least, etc.

(b) Co-curricular section—
Estimates of work, especially in the following areas: debates, magazine, nature study, craft work, gardening, wood work, manual work, music, drawing, painting, first aid, co-operative stores, sewing, social welfare, physical training, national service, etc.

10. Attendance.

11. Home circumstances—especially number of school-going children, economic status, family attainments and occupation, feeling of security, encouragement for higher education, etc.

12. Course group or stream recommended for further study.

13. Subjects recommended for further study.

14. Vocational or occupational training suggested.

15. Special remarks, if any,
(i) by the class teacher.
(ii) by the counsellor.
(iii) by the headmaster.

Signature of
the class-teacher.

Signature of
the counsellor.

Signature of
the head master.

CHAPTER X

Parents' Questionnaire and Pupils' Questionnaire

It has been suggested before that (useful information may be collected from the pupils themselves and their parents.) Many an educator¹ emphasized the value of such data collected through questionnaires or inventories. In the normal procedure for guidance, followed at the National Institute of Industrial Psychology in England, a record form² is provided which is to be filled in by the parents or guardians of the individual concerned. The record form is intended to collect some factual biographical data besides the dispositional qualities and interests of the candidates. In case of adults, the record form is filled in by the applicants themselves. It has been suggested³ also that adequate provision should be made for recording children's own likes and dislikes, the wishes of their parents, the socio-economic factors of their family and the hereditary occupations, if any.

The questionnaires, to be devised for the purpose, should be of the type of a biographical history on specific points relevant to the present issue of 'allocation'. The biographical investigation to be done through these questionnaires is expected to be of great help to the guidance worker while effecting a satisfactory synthesis of the different aspects of the pupils' personality as reflected in assessments made through tests of abilities, attainments, interests, etc. as well as in reports of the school cumulative record card. The cumulative record card may provide the basis for making such a synthesis, at least, in respect of the pupils' life at school; but it is better to get these records supplemented by enquiries directed towards the

¹ *Brit. J. Educ. Psychol.* XVII, 1947, pp. 20-39.

² Form V.G.J.I of N.I.I.P. (England).

³ The first Interim Report of N.F.E.R. (National Foundation for Educational Research in England and Wales), 1950.

pupils' life outside the school, especially their family-life. It goes without saying that the value of a biographical history, as depicted through the questionnaires, will be greatly enhanced if a number of sources can be usefully tapped, e.g. the pupils themselves, their parents or guardians and their peers. The information thus collected may help one develop the correct perspective in which the different dimensions of the pupil's personality may be suitably placed for better interpretation or understanding.

Besides, (the questionnaires will also satisfy a very important and pressing need of the guidance programme as such. The use of these questionnaires would obviously suggest that the pupils and their parents are being taken into confidence in respect of a problem-situation which affects them most.) The enlistment of their participation and co-operation in the matter will definitely go a long way to popularise the scheme as a whole. The administrators of guidance services in schools will always consider it a significant gain on their part, if they are assured that the pupils and their parents have been led to feel that their likes and dislikes, their wishes and inclinations, their observations and suggestions are duly respected. As has been revealed from the follow-back enquiry,¹ conducted by the National Foundation for Educational Research, the attitude of the pupils and their parents, adapted or developed towards the school and its teachers, is a thing of great significance.

* * * * *

Accordingly, we propose to use the following two forms of questionnaires, one for the parents or guardians and the other for the pupils. (The different items of the questionnaires have simply been narrated here. They should be set in proper form when these questionnaires are to be made ready for actual use).

¹ N.F.E.R. (England & Wales), Allocation Studies II, in Collaboration with the Middlesex Education Committee (1952-53).

Parents' Questionnaire

(to be filled in by parents or guardians)

- I. Personal data of the pupil (including name, date of birth, address, etc.).
- II. Names of parents, brothers and sisters, guardians other than the parents (if any), with their academic attainments.
- III. (a) Present occupations of the parents or guardians, brothers and sisters.
 (b) Family occupation, if any.
 (c) Occupation contemplated in the present case i.e. the pupil concerned (not more than three in order of preference with reasons).
- IV. Health : general condition, serious illness or operation (if any), physiological defects, if any.
- V. Disposition :—behaviour disorders (including emotional and nervous difficulties), if any, dispositional qualities of special note: e.g. resourceful, persevering, systematic, responsible, ambitious, etc.
- VI. Interests and Activities:—

(a) Family interest of special note.	Not more than two to be checked of the list below :
(b) Special interest of the child.	Literary, scientific, mechanical, mathematical, musical, artistic domestic, business-minded, agricultural, outdoor, social, etc.

(c) (i) Activities which interest the child the most. Not more than three to be checked of the given list :

(ii) Activities which do not interest the child at all.

Reading, writing computation, domestic work, social service, gardening, mechanical work, cooking, metal-work, first-aid, wood-work, science, teaching, accounting, acting, debates, music, drawing, etc.

VII. Educational (general) :

(a) Whether family circumstances permit further education of an advanced nature:—

(b) In case of further education, which streams of the diversified courses preferred : (Not more than two in order of preference) Humanities, Science, Technical, Commercial, Fine Arts, Agriculture, Home Science.

Pupil's Questionnaire
(to be filled in by pupils themselves)

I. Personal data (including name, date of birth, address, etc.).

II. Health—serious physical disability or handicap, if any.

III. Interests and Activities :—

(a) Field of special interest :
(Not more than two to be checked of the given list)

Literary, scientific, mechanical, mathematical, outdoor, social, domestic, artistic, musical, agricultural, business minded, computational, etc.

(b) Leisure-time activities or hobbies, if any :

(c) School activities liked most :
(Not more than two to be checked of the given list)

Debates, games, social service, gardening, handicrafts, cooking, mechanical work, woodwork, sewing, magazine, co-operative store, music and drama, first-aid.

IV. School subjects :

(a) School subjects liked most : [Not more than three subjects should be given].

(b) School subjects liked least :

(c) Selecting subjects for further study, if required :

(Not more than four to be checked of the given list).

Mother language, foreign language, classical language, history, geography, psychology, logic, mathematics, physics, chemistry, biology, botany, physiology, geometrical drawing, engineering, commercial geography, civics, economics, shorthand and type-writing, book-keeping, animal husbandry, dairying, farming, crop culture, drawing, painting, music, dancing, sculpture, modelling, domestic hygiene, child care, household management, food and nutrition, cookery, house-craft.

V. Occupational aims :

Occupations of choice (only two to be mentioned with reasons):

VI. Educational goal (general) :

(Selecting only one out of the seven streams of the diversified courses)

Humanities, Science, Technical, Commerce, Fine Arts, Agriculture, Home Science.

VII. Special information about personal attitudes and temperament (if any):

CHAPTER XI

The Total Picture

We have outlined a network of 'tools',—tests, inventories, record-forms and questionnaires, for collecting useful information about pupils whom we are to advise in the choice of their higher secondary courses. All these separate items of information may, in a sense, be regarded as mere 'abstractions' of a pupil's personality. The different sets of data representing only different aspects or dimensions of the child's personality should never be regarded as anything more than mere sketches in the main framework of a total picture, and it is for us, in our description of the child, to put in the outlines, the shadings, the high lights and everything that makes the person unique.¹ But how are we to draw that composite picture?

We should always remember that we are primarily concerned here with differential prognosis. In other words, we are to see that the data so accumulated about an individual are organised in such a way that they help us discriminate between his estimated status in a number of assessment-areas.

We are, therefore, to use the data about the child's personality *relatively* in order to ensure comparability between different sets of data corresponding to the different streams of our multilateral education. The data, as we know, are characterised by scores, rating or estimates, on a series of tests, inventories, questionnaires and records. We know also that the test-scores do not always behave in the way we would expect them to do, from a superficial examination of their content or form. Some would suggest² that a great deal of systematic study, combined with some appropriate method of 'analysis' would be

¹ Stephenson, W.—*Testing school children*, Longman Green & Co. 1949, p. 89.

² Morrisby, J. R.—*The Differential Test Battery—N.F.E.R. (England & Wales)*, Bulletin No. 6, Nov. 1955, p. 31.

needed before the exact nature of mental structures characteristic of success in various school subjects and occupations could be established with any real degree of precision. We should note that none of these test-scores can provide an index of absolute measurement understandable by itself. Let us, however, clarify this point further.

No direct comparison is possible between measurements of different traits, or, measurements of the same trait by different tools or techniques, or, even measurements of the same trait by the same tool but administered under different conditions. In order to ensure this direct comparability, we are to satisfy certain basic requirements, namely, similarity of samples, equal reliability of measurements, similarity in form or shape of the measurement-distributions and equality of units. In other words, we are to devise a suitable method of scaling these 'raw' measurements. The problem of scaling depends, for its right solution, upon the location of a suitable reference-point on the right scale of observation. The units we ordinarily use in mental and educational measurements are not equal throughout the measuring scale and there is also no true zero-point on this scale to serve as a suitable point of reference. The zero-point we select for a particular test-scale is purely arbitrary. We cannot say that a boy who scores zero in an intelligence test possesses no intelligence at all. In the same way, we cannot say that equal differences of scores in mental or educational tests indicate equal differences in mental or educational ability. Facts like these constitute a serious handicap to our psychometrical progress. After years of hard labour, psychometricians seem to have arrived at a statistical solution of the problem.

Ordinarily, the following statistical methods¹ are employed for converting the obtained 'raw' scores into comparable measures:

- (I) Percentile scaling.
- (II) P.E. Scaling (very rarely used).

¹ Garrett, H. E.—*Statistics in Psychology and Education*—
Longman Green and Co., 1947, pp. 149-57.

- (III) Sigma (σ) Scaling.
- (IV) T-Scaling.¹
- (V) Product-Scaling (for conversion of judgments, ratings, etc.).
- (VI) Scaling of Estimates² (for conversion of raw estimates on different traits or qualities).

* * * * *

Whatever be the method adopted,* we would get different sets of derived scores in respect of different traits, and, these derived scores are comparable to one another. Since we are interested in differential prediction, arrangements should also be made to represent these derived scores graphically in different sections each one of which might reasonably stand for a particular stream. These sectional graphs are technically known as 'profiles'.

Profile-analysis :

'Profile-Analysis' is a special form of graphical analysis of the individual's scores on a number of tests, inventories, etc., and it is considered to be a very useful device for understanding 'multigrouped data' (as envisaged here) in the most meaningful way. (Further notes on 'profile analysis' are placed in Appendix B, p. 121). These sectional graphs or profiles with their positions (levels), scatters, shapes or forms are expected to show very clearly the 'patterning' of the individual's abilities, interests, attainments and personality traits, in respect of the areas to be considered. It would thus help us, in the first instance, to grasp quickly and accurately how the particular individual stands in relation to the *average individual* of the same group.

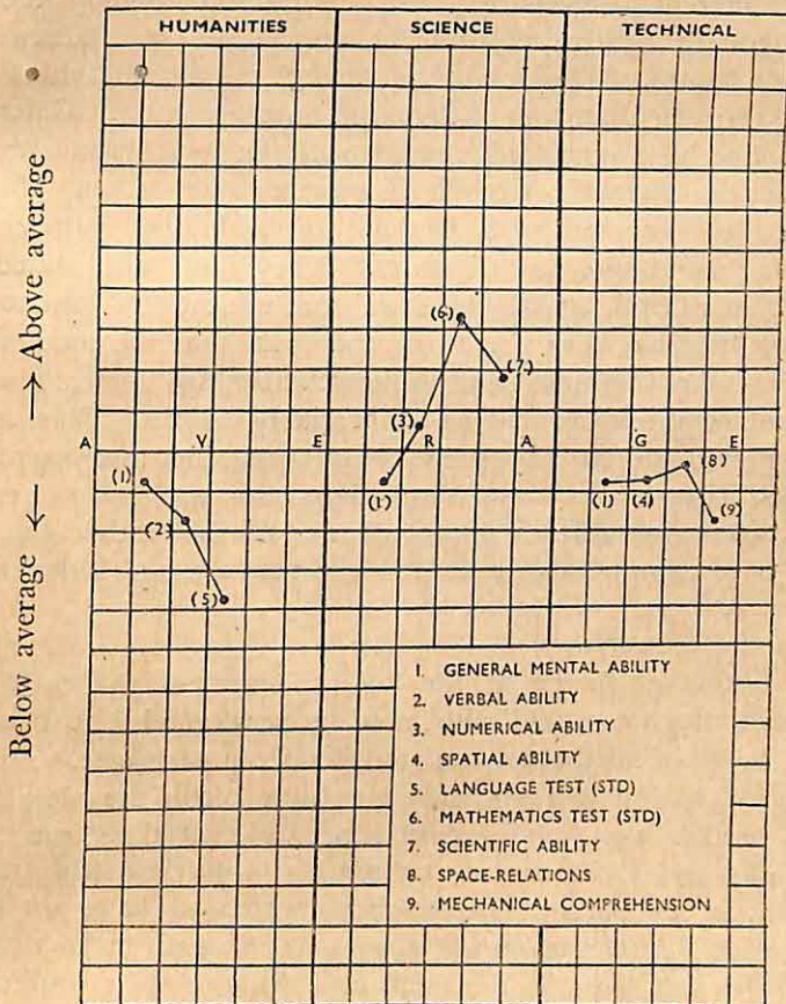
¹ The writer once suggested a modified T-Score Table in his article T-score Transformation,—A suggested modification, *Educ. & Psychol.* (India), II, No. 3, (1955), pp. 1-11.

² McClelland, W.—*Selection for Secondary Education*—University of London Press, Ltd., 1942, pp. 34-47.

* The writer does not like to discuss here merits of each of these technical methods. Reference may be made to any standard book on 'Statistics in Psychology and Education', where adequate treatment on all of them would be readily available.

[The 'profiles' of an individual (in respect of only three streams, humanities, science and technical) are reproduced below as an illustrative example.]

TEST RECORDS
DISTRIBUTION OF PROFILES



The above distribution of profiles shows that the individual concerned is likely to do better in the 'science' course than in either the 'humanities' or the 'technical', of course, from the stand-point of test-records only.

Secondly, as we would have seven profiles corresponding to seven different streams of the diversified courses, the profiles with their 'levels', 'scatters' and 'shapes' or 'forms' considered together are expected to help us make a comparative study of the individual's standing in regard to the different subject-areas and understand thereby the individual's relative position in respect of the different course-groups. The total '*patterning*' of the individual will thus facilitate our differential interpretation. Gaier and Lee have remarked¹ that one of the most promising trends in current psychometric research has been the increasing concern with methods of evaluating *patterns of test-scores and test-responses*. They have also stated that, in clinical, vocational, social and educational psychology, there has been a growing consensus that the method which takes due note of the inter-relationships among test-variables would contribute appreciably to the efficiency of prediction by any such programme, the assumption being that higher validities might be obtained when predictive variables are treated as '*patterns*' rather than as mere '*summation*' or 'average' of separate and independent scores.

Guidance Schedule :

In order to get at the 'total picture' of the child's personality we would also need a very good but brief summary of all the accumulated details in each case. This summarisation will not only give us a bird's eye view of the child's assets and liabilities in different directions, it would also facilitate our subsequent interview with the child or its parents and teachers, which we have got to arrange. Attempts should always be made to make these interviews adequate, thorough and deep in their implications. They are to supplement most of the information collected earlier from different sources and to clarify many controversial points or inconsistencies. They are also expected to help us unearth the real conflicts and seek out possible ways of their resolution.

¹ Gaier, E. L. and Lee, M. C.—'Pattern Analysis—A configurational approach to predictive measurement'—*Psychol. Bulletin*, 50, no. 2, 1953, pp. 140-48.

It is, therefore, reasonably demanded that a suitable form, of the type of a schedule, should be developed for a consolidated summary of all the significant data collected about any individual pupil. Dempster,¹ while discussing the question of selection of pupils for different types of secondary education, duly emphasized the need of a similar document, a guidance schedule, which would duly embody all the essential and important points in the most compact and meaningful way.

A provisional form of the 'guidance schedule' is proposed below:

Guidance Schedule

- A. *Personal data* of the child including name, date of birth, father's name, guardian's name, address, etc.
- B. *Important features of the child's personality:*
 - (I) Health—qualities of special note.....
.....disabilities or handicaps.....
 - (II) Temperament special merits.....
.....and character defects or drawbacks.....
.....traits.
 - (III) Anything else
.....to be specially
.....noted.....
- C. *Educational opportunities:*
 - (I) Socio-economic status
.....of the child's family:.....
 - (II) Educational opportuni-
.....ties readily available.....
- D. *General educability:* 'Profile' distribution of *derived scores* in,—
 - (I) General mental ability.
 - (II) Standardised tests of mother language.
 - (III) Standardised tests of arithmetic.
 - (IV) Teachers' estimate.
 - (V) Ratings in regard to the important personality
.....traits.

¹ Brit. J. Educ. Psychol.—XVIII (1948)—pp. 121-33.

E. *Differential Traits*:

- (I) Distribution of achievement-test scores (derived scores) in different school subjects, organised in seven sectional profiles.
- (II) Distribution of psychological data in respect of (a) abilities and (b) interests, these being arranged in seven sectional profiles.

F. *Educational Inclinations, Preferences, etc.*

Distribution of educational inclinations or preferences, (again in seven sections) as inferred from the child's likes and dislikes, preferences for activities and school subjects, vocational goals, interests, educational choices, etc. etc., all collected from different items of the pupil's questionnaire, the parent's questionnaire and the school record card.

G. *Interview Findings (of special note)*:

- (I) With the child.....
- (II) With the parents
or guardians.....
- (III) With the teachers.....

H. *Recommendations* :

- (I) Prognostic.....
- (II) Diagnostic.....
- (III) Others (if any).....

I. *Final 'Orientation' Interview* :

- (I) With the child.....
- (II) With the parents or guardian.....

We should, however, sound a note of warning here. In course of arriving at a synthetic picture about the child from the consolidated data compiled systematically in the proposed 'guidance schedule', one would usually face problems of the type suggested by Lopez¹ :

- (a) Disparity between findings of educational inclinations and those of abilities and/or attainments.
- (b) Incompatibility between educational fitness and the health.

¹ Lopez, E. Mira Y.—'Seven Problems of Synthesis in Vocational Guidance'—*Occup. Psychol.* 28 (1954), pp. 34-40.

- (c) Disagreement between child's fitness and parents' wishes.
- (d) Conflict between child's fitness (abilities, attainment and preferences) and some temperamental or character traits (or personality-trends).
- (e) Problem of financial difficulties in case of children otherwise fit and well-suited.
- (f) Disagreement between individual suitability and social (or national) interest.
- (g) Disparity between potentiality and attainment or between interest and abilities/attainment.

Some of these problems may become so overwhelming in nature that they are likely to place us in a very difficult situation. Often times, it may not be possible for us to face them squarely or to resolve them satisfactorily. But saddled as we are with the task, we can not avoid them altogether; nor should we try to ignore or minimise their importance. We have got to live with them and adjust ourselves accordingly. Let us boldly meet them in our practical life and see if they really turn out to be irresistible or unassailable. Let us try to make ourselves adept in resolving the conflicts or reconciling the contradictions. The knowledge that we thus acquire, the experience that we gain and the way our knowledge and experience get enriched through continued practice,—all these will make the path easier for us and help us reach nearer the goal, if not attain it outright.

CHAPTER XII

Concluding Notes

We have outlined here a very elaborate and extensive programme to solve most of the intricate issues connected with the problem of educational (curricular) guidance for children going on to higher secondary education at the age of 14 plus. Although we have tried to frame up the plan in an apparently precise and systematic way, we must be very cautious about its actual execution. We believe that educational psychology today is 'alive, alert and explorative' and as such, it is better able to stand up to the rigorous demands of our present-day requirements. But we should also bear in mind that the finalised interpretation of all our accumulated findings must be made in the light of certain other conditions which are sometimes so important as to override the indications of test-scores or other psychological data. It has been rightly remarked¹ that the introduction of psychological methods should not involve dogmatic, arbitrary or bureaucratic directions of human beings. On the contrary, we should emphasize and put much stress on the '*individuality*' of personality with its unique possessions of abilities and interests, attitudes and motivation.

We should also develop a belief in the great power of *environment* to influence the degree and direction of the individual's growth. We must not want to be strict executives who carry out their plans literally and blindly without taking into consideration all other relevant factors or without attempting to exercise the highly-valued quality of 'human Judgment'. "It would be unpsychological for a psychologist to impose on anybody a ready-

¹ Vernon, P. E. and Parry, J. B.— *Personnel Selection in the British Forces*, University of London Press, Ltd., 1949, pp. 281-82.

made plan.'¹ We should reaffirm with Percival Smith² that, though valuable assessments in certain directions can be made by the use of modern psychological 'instruments', the *comprehensive analytic study* of each individual should always remain the ultimate goal.

Working as technical advisers, we would rather try to arrive at certain inferential recommendations which are very likely to suit best the individual child on the one hand and the parents, teachers and, for the matter, the society and the nation on the other. Vernon once stated³ that educational psychology might not affirm the soundness of an educational policy, but it could be of great use in a *negative* way. That, perhaps, is an approach in the right direction. All the test-findings together with other important data would be placed alongside our suggestions and recommendations, at the service of the pupil, the parents and the teachers, so that the pupil might conveniently regard them as his helpful guides and the parents and the teachers might do all in their power to help the pupil develop properly and adequately in reference to his assets or potentialities, as far as practicable.

Our objective will be *to work with*, rather than *to work on*, the individual being guided. We should never lose sight of the fact that part of every individual's potentially is his capacity for self-direction. We should, therefore, be greatly "concerned with helping the individual help himself to see relationships among people and events in his experience, to think through his own problems, to gain insight and to make plans".⁴ The three principles of 'acceptance', 'progression' and 'self-direction' should permeate all our activities in this regard.

¹ Vernon & Parry—*ibid*, p. 282.

² Smith, P.—'Twenty-five Years' of Research in Vocational Guidance'—*Occup. Psychol.* XXV (1951) pp. 35-43.

³ Vernon, P. E.—'Modern Educational Psychology as a Science', Univ. of London Institute of Education, Studies in Education, 1952, p. 29.

⁴ Rivlin and Schueler (ed.)—*Encyclopaedia of Modern Education*, The Philosophical Library of New York City, 1943, p. 353.

We are not to dismiss straightway the doubts among a section of teachers and parents about the intrinsic value of guidance processes. These doubts "arise in part from well-founded distrust of the over-confidence of some of those who use the new techniques of personality-assessment,—an over-confidence which derives in some measure from sheer confusion between science and administration".¹ Engrossed as we are with the delicate theories and subtleties of science, we oftentimes forget that we could manage to devise *mainly* an administrative procedure. The scientific contents of the theories that govern our guidance procedure are relatively small and the tools (i.e. tests, record forms, questionnaires, etc.) that we use are more administrative than scientific in character.

On the other side, our task will always be to undertake more and more investigations in the field; and during the period of continued experimentation, we should always be evaluating our present programmes, refining our existing tools and techniques and exploring newer and newer possibilities to suit the intriguing and expanding complexities of human life. The ultimate goal of all such research-work will always be to raise higher and higher the predictive value of the accepted plan as a whole, to make it more and more workable and to suggest more and more confidently what we may usefully expect of our younger generation.

¹ *The Journal of Education*, London,—89-1051, Feb. '57, pp. 68-69.

Appendix A

Recent Developments in Factor-analysis

• The introduction of factor-analytic method has been contributing much towards the expansion of the field of psychometry as well as the development of general theoretical lines in psychology, i.e. the examination of mental functions and the exploration of mental forces. It is natural that a solid methodological basis of any young science leads to further development of the theoretical aspect of the science itself. As Ahmavaara has put it,¹ "All the possibilities created by the new differential methods presumably cannot be seen as yet; a theoretical all-around picture is only beginning to take shape and connections between its different parts are mostly still to be found. The methods themselves too are still very much in a state of evolution".

Progressive Differentiation of Factors :

Ahmavaara himself, with his two new methodologies, (a) the Transformation method (purporting to answer the question of how to make exact comparisons possible between factorial studies carried out with different experimental population) and (b) the Residual Spectra (cf. Godfrey Thomson's ideas in regard to minimising the number of common factors in factor-analysis),—has tried to throw new light on the structure of mental abilities. He has demonstrated, after applying his new method to Thurstone's basic studies on 'Primary Mental Abilities', that the so-called primary factors show a tendency to break up into 'fine structure components'. The differentiation of Thurstone's primary factors into fine structure components may also suggest that these primary factors might themselves be the components into which Spearman's 'g' would be differentiating. He has been led to

¹ Ahmavaara, Y.—*Transformation Analysis of Factorial Data*, Univ. of Helsinki, 1954, p. 4.

believe that the multitude of new factors met with in recent factor-studies arise from the fact that the fine structure components of the so-called primary factors have been brought to the foreground in various degrees, the *number* (of factors) depending on the *nature* and the *structure* of the test batteries used as well as on those of the experimental population. With young children, one might get only a single factor, 'g', but with the experimental population getting older and older, the components of human ability would come out more and more differentiated. Shartle's and Guilford's factors, when placed against Thurstone's, would perhaps lead one to agree to what Ahmavaara has stated. Burt's and Vernon's views about the hierarchical structure as well as Thomson's 'Sampling' theory might also be corroborated by Ahmavaara's configurational conception of factor-analysis. The psychological properties of the experimental population, as manifested through the test-situations used, are reflected in the configuration of test-vectors in the factor-space. With the experience of the experimental population becoming more and more diversified in course of their increasing age, the configurational field of test vectors in the factor-space is likely to be expanded in dimensionality. In terms of factors, it may be explained as the progressive differentiation of factors, the original factors being resolved into their relatively 'fine structure components'.

Limitations of factor-Analysis :

"It is however an unfortunate characteristic of factor analysts that their interest in factors makes them blind to the importance of behaviour and performance."¹

Oftentimes we forget that the so-called 'factors of mind', derived out of elaborate analysis, are merely mathematical constructs which account for the objectively determined correlations between tests, and that fundamentally, these factors may not be psychological entities at all, though we usually wish to theorise about their psychological origin and nature. We must note that,

¹ Sup^c Donald, E.—*Personnel Guid. J.*, A.P.G.A., Dec. '56, p. 224.

besides the highly complex and controversial issue of identifying and naming them, all these factors "should be regarded primarily as categories for classifying mental and behavioural performances, rather than as entities in the mind or nervous system".¹ Such mathematical factors might also arise even if the mind is supposed to be consisting of an innumerable number of bonds including inherited reflexes, acquired habits and associations, etc.² The so-called 'Factors' or components of the mind should not therefore be reified into *static faculties* and considered as *unitary* powers or *immutable* organs of the mind. *They are likely to be modified to a great extent by one's upbringing and education.*

According to Tryon, a factor (or component) should be thought of as representing a continuum (variable) in terms of which individual differences in observed behaviour can be partially described. A factor does not necessarily mean a primary or causal determiner of individual differences. It may refer to a *complex* variable which itself again is the effect of a coalition of many primary determiners. "It may be, in fact, a mere scale or mathematical axis, serving as one dimension or as an arbitrary frame of reference in which measures of behaviour are located for study. Such indeed are the factors arising out of the current techniques of 'factor-analysis' and as such they have no psycho-biological meaning."³

Even in the mathematical aspect of factor-analysis, we are faced with conflicting views. Ahmavaara, while discussing the general significance of "Residual Spectra"⁴ has raised the same question as Godfrey Thomson did several years ago,⁵ regarding the arbitrary practice of maximising the specifics and consequently minimising the

¹ Vernon, P. E.—*The Structure of Human Abilities*—Methuen & Co., 1950, p. 8.

² Vernon, P. E.—*ibid*, p. 31.

³ Tryon, R. C.—*Cluster Analysis*—Edwards Brothers Inc. Michigan, 1939, p. 1.

⁴ Ahmavaara, Y.—*Transformation Analysis of Factorial Data*—University of Helsinki, 1954, pp. 122-26.

⁵ Thomson Godfrey,—*The factorial Analysis of Human Ability*, Univ. of London Press, London, Chap. VIII (1948).

communalities as well as the number of common factors. Thurstone¹ however contended that the communalities and the number of common factors would be determined uniquely by the side-correlations and that they would be neither minimised nor maximised in the analysis. Ahmavaara² holds that the occurrence of 'Residual Spectra' indicates that in practice there happens minimisation of communalities and of the number of common factors as well as maximisation of the specific variances and that there are 'latent' common factors which have remained unidentified owing to, perhaps, their insignificant effects in the study at hand. He attributes the last residual to the effect of factors whose differentiation is still under way and as such the differentiated 'fine structure components' cannot yet be identified. But the fact is that these factors do exist even though in *embryonic* forms. This general process of differentiation is quite evident from factor-studies with adult subjects as against those with children, on the same battery or type of tests.

Another very important point should be stressed here. Our present-day testing of mental abilities pertains mostly to comparatively undifferentiated wholes and consequently the score of an individual in any such test does not disclose anything more than an *estimate* of his or her *average* ability in a particular field as represented by the sample items of the test concerned. But the two words 'estimate' and 'average' usually escape our attention and we normally form such notions about *ability-measurement* as are likely to be misleading and sometimes even anomalous.

One such crucial issue has already been raised by the research workers at the National Foundation for Educational Research in England and Wales. After the Foundation's national survey in 1955, of abilities and attainments of school children aged 10 years 8 months to 11 years 7 months, the traditional ideas about 'Achievement Quotient' and its distribution in the population

¹ Thurstone, L. L.—*Multiple factor Analysis*, Univ. of Chicago, 1947, pp. 287-89.

² Ahmavaara, Y.—Loc. Cit.—p. 123.

along with the resulting notions of 'under-achievement' and 'over-achievement' have been seriously challenged.¹ The factual evidence of the normal distribution of 'Achievement Ratios' obviously demands self-criticism and, perhaps, reformulation of our theories. We should bear in mind Mr. Brimer's warning² that mental tests do not measure power except in an analogical way; i.e. they measure behaviour in a given set of situations and their results are used to predict the individual's future or concurrent behaviour in similar situations obviously within certain limits of test-error.

Lastly, we should note that the complex and highly controversial issue of identifying and naming the factors usually leads to serious misunderstandings. The users of the factor-tests, quite ignorant of the dangers of the "*naming fallacy*" (of which the factorists themselves are well aware) take the findings of the tests at their face-value and, as a result, many undesirable practices creep into our guidance work. From one's performance in the test of a particular factor, we hastily jump to the conclusion that one would surely do well in a specific type of education or job, without caring in the least for the actual predictive validity of the test concerned.*

¹ Bulletin No. 8, Nov., '56, *N.F.E.R.* in England & Wales, pp. 24-33.

² Bulletin no. 8, Nov. '56, *N.F.E.R.* in England & Wales, p. 29.

* Interested readers are referred to the series of symposium published in detail in the journal *Educational and Psychological Measurements*, XVIII, No. 3, 1958, pp. 455-515.

Appendix B

Research Methods for Differential Prediction

Researchers in the field of education usually recommend one of the following methods in connection with studies on differential prediction :

(Only the central objectives of the methods are given below).

(a) *Correlation* :

With the help of correlation technique¹ we show that certain abilities or certain degrees of a particular ability are mostly associated with successful achievements in a particular subject or subject-group.

We may also point out that certain subjects go to cluster² together to form a broader grouping represented, on the main, by a particular ability or ability-group.

(b) *Factor-analysis* :

We may analyse the performance or achievement of individuals in respect of different subjects or subject-groups into 'factors'; then, from the nature and structure of the factors so derived³, we may try to show that certain subjects or subject-groups usually correspond to certain 'factors' or 'factor-groupings'.

(c) *Analysis of Variance and Discriminant Function⁴* :

These are two statistical devices to test the significance of the difference between any two groups or sets of scores.

With the help of these two techniques we may try to demonstrate that certain subject-groupings do differ amongst themselves, in as much as they demand differential mental structure for one's successful achievement in them.

¹ Earle, F. M.—*Tests of Ability for Secondary School Courses*, Univ. of London Press, Ltd. 1936.

² Kerr George—'Aptitude Testing for Secondary Courses'. *Occup. Psychol.* 16, April, 1942, p. 73-78.

³ King, W. H.—Ph.D. Thesis, Univ. of London, 1949.

⁴ Penfold, A. P.—M.A. Thesis, Univ. of London, 1954.

(d) *Profile-analysis* :

We may try to derive, from a graphical analysis of the individual's scores on a battery of tests comprising a number of factors or abilities, the 'ability-profile' or 'factor-patterns'¹ which are reasonably connected with successful achievements in different subject-groups. With the help of such discriminating profiles², we may subsequently make an estimate of the relative achievement of an individual in diversified areas of study or work.

Certain other methods, like 'dispersion analysis' 'agreement analysis', 'cluster analysis'³, D^2 statistics, etc.⁴ when fully developed, may also prove to be of great value for differential prediction.

* * * * *

All these methods, again, are applicable to the two different types of studies, namely, (i) cross-sectional and (ii) follow-up. It is perhaps universally agreed that evidences from the *follow-up* studies should be given more weight and significance than those from the *cross-sectional* ones.

¹ Schneidler and Berdia—'Educational Ability Pattern' *J. Edu. Psychol.*—33, Feb. 1942, pp. 92-104.

² Cardinet Jean—The use of Profiles for Differential Prediction, *Educ. Psychol. Meast.* XIX, No. 2, 1959, pp. 191-205.

³ *Educ. Psychol. Meast.*, XVIII, No. 3, 1958, pp. 455-515.

⁴ Rao C. R.—*Advanced Statistical Methods in Biometric Research*, John Wiley and Sons, New York, 1952.

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